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ANIMAL FEED INDUSTRY IN AFRICA

Background paper*

Prepared by

Ibrahima Lamine Diarra
UNIDO Consultant

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* The views expressed in this paper are those of the author and do not necessarily reflect the views of the Secretariat of the United Nations Industrial Development Organization (UNIDO). Mention of firm names and commercial products does not imply the endorsement of UNIDO. This document is a translation of an unedited original.

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I. METHOD AND ORGANIZATION OF RESEARCH

1. These studies were organized through direct inquiries in a certain number of countries, viz. the Central African Republic, Rwanda, Cameroon, Togo, Côte d'Ivoire, Benin and Mali.

2. The budget and the established deadlines made it impossible to cover a larger number of countries with any degree of thoroughness.

3. In the countries visited, priority was given to visits to animal feed manufacturers and to suppliers of technology, whether local or imported.

4. This approach made it possible to focus in a specific way on the problems that are arising and to formulate proposals for solutions to immediate and medium-term concerns. The interviews were supplemented by documents supplied by technical departments in the various countries.

5. The approach used to obtain an appropriate focus on the animal feed problem in Africa south of the Sahara was as follows. Three countries were selected from among all those visited, namely Rwanda, to represent the eastern part of Africa, the Central African Republic to represent the centre, and Mali to represent the west.

6. In these different countries, the contacts that were established made it possible to analyse discrepancies between feed production and actual needs, to find out what raw materials are available and actually used, and to identify the constraints and the principal bottlenecks - in technology, in the organization of production and in the provision of information.

7. Analysing these different constraints and bottlenecks together, we were able to formulate specific proposals for animal feed production - proposals designed to improve both the quality of manufacture and the quantities produced.

8. In presenting the results obtained by subregion, we shall first take up questions of the organization of industrial production and raw material production, and of the technologies used and the principal bottlenecks encountered.

II. GENERAL AND SPECIFIC PROBLEMS

Potentialities and constraints by subregion (east, centre, west) in Africa

Central subregion: the Central African Republic

9. The Central African Republic, like all the countries of Africa south of the Sahara, has one principal objective: self-sufficiency in food production, adequate and reliable food supplies for its population through effective and independent use of the country's agricultural and livestock resources, with the development of activities such as large and small animal husbandry,

poultry production and fish pond farming. All this requires that adequate feed should be available for the animals - feed of good quality at accessible prices. At present, the Central African Republic has no animal feed production plant.

10. One consequence of this situation is that there are no animal feeds available based on clearly defined nutritional formulae and adapted to available local raw materials.

11. This being so, the growers, in particular poultry breeders, tend to make up the feed themselves on a small scale.

12. These feeds are then given to animals derived from carefully developed imported stock, the result of long and careful selection. This applies in particular to poultry.

13. These quality animals cannot yield the results expected of them unless they are raised in suitable conditions, including good food, good sanitary accommodation and a wholesome environment. Thus the establishment of a feed plant is an urgent necessity.

14. The raw materials that could be used for the production of animal feed in the Central African Republic are numerous.

15. Regrettably, most of these products - and in particular certain by-products - are not properly utilized despite their nutritional value, and despite the fact that they are available at modest prices and sometimes even free of charge.

(A) The raw materials available locally are:

(1) Cereals:
- Maize
- Sorghum
- Millet

16. These are seasonal crops. There is no policy aimed at encouraging production, and as a consequence the peasants simply sell the surplus remaining after immediate consumption of the rest.

Part of the cereals used for poultry growing comes from neighbouring countries, and interruptions in the availability of stocks are frequent. Prices fluctuate depending on the time of year.

(2) Animal meals:

- One such product is blood recovered in the slaughterhouse, which is boiled and dried on a cottage industry basis. Given this type of processing, the nutritional value of the product is doubtful and certainly does not match the qualities of a blood meal produced industrially;

- Another is the residue from smoked fish sold in the market-place for human consumption. The nutritional value of this product is variable; it is found only sporadically, and the quantities available are not enough to sustain any sizeable feed production.

17. However, such by-products could provide a focus for research aimed at bringing about subregional or regional cooperation in Africa. There are, after all, zones in Africa which could supply their by-products in large quantities if promoters could be sure of reliable markets for them (with payment in money or in barter).

(3) Minerals:

18. Bones and calcined oyster shells provide the main source of phosphorus and calcium.

(4) The by-products of agriculture and the agro-industries are as follows:

- Cottonseed and palm-oil cakes;
- Brewery draff;
- Rice bran;
- Treacle;
- Plantain banana skins;
- Spoilt plantain bananas;
- Spoilt cassava;
- Cassava tubers;
- Cottonseed;
- Groundnut shells (to some extent).

(B) Imported products

The principal imported products are:

- Vitamin-enriched mineral complement;
- Concentrates;
- Pre-mixed feed.

19. To sum up, the Central African Republic has the basic requirements and the potential for producing animal feeds. Adequate demand is also potentially there, and it will be important to satisfy that demand by encouraging the installation of medium-sized industrial units in the private sector.

20. This is virgin territory, and the objective of self-sufficiency in food supply can only be attained with effective livestock breeding, which in turn makes demands on agriculture, forestry and fishing.

Eastern subregion: Rwanda

21. In Rwanda the raw materials used for the production of animal feeds include:

- Cottonseed cake, generally imported;
- Wheat and rice bran;
- Maize, and sometimes sorghum and soya.

22. A point to be noted is that the possibilities are by no means exhausted, because certain industrial products exist which are not being utilized. These include:

- Dried brewery draff and yeast from the breweries;
- Treacle from sugar mills;
- Bran and remilled residues from flour mills;
- Rice bran from rice mills.

23. At present the main source of animal feed in Rwanda is pasture grass, various fodder crops and plants from anti-erosion hedges, consumed primarily by ruminants (cattle, goats and sheep).

24. As far as non-ruminants are concerned (chickens and pigs), Rwanda relies to a large extent on feeds produced by small-scale cottage industry or by animal feed plants such as SOPAB, COVAZ and DPE. The first of these - the Society for Animal Feed Production - is now producing 3,200 tons per year for an installed capacity of 12,000 tons per year.

25. The COVAZ Society, whose activities have been shut down, had a capacity of the order of 110 tons per day, or an annual tonnage of approximately 2,500 tons.

26. The feeds thus produced are used mainly by dairies, poultry farms and pig farms.

27. There is, moreover, a project for the development of small animal feed (DPB), with an annual production of 1,200 tons.

28. At present Rwanda could marshal immediately about 6,000 tons of agro-industrial by-products which would make it possible to produce 40,000 tons of animal feed.

29. The use of concentrated feeds is comparatively rare. Only a few growers, described as "modern", a few dairy farmers and some pig farmers purchase these feeds and give them to their animals.

30. The demand for such feeds accordingly remains slight in Rwanda, largely because the feeds are expensive and the purchasing power of the growers is low because their activities do not yield sufficient revenue.

31. As regards animals in the so-called "modern" sector, we have to estimate the consumption required to satisfy potential demand, bearing in mind that consumption per cow is estimated at 2.5 kg per animal per day, consumption by pigs at 2 kg per animal, and consumption by poultry at 125 grams per animal.

32. Thus, in 1992 the needs of the "modern" sector were estimated at 26,746 tons, a figure which is expected to rise to 50,710 tons by the year 2010. The availability of by-products would make it possible to produce about 40,000 tons of feed on condition that they were supplemented with protein-rich elements and by a greatly increased utilization of certain oilseed products; if all this proves to be possible, Rwanda should be able to attain self-sufficiency in animal feed production, since a programme for the development of oilseed products would permit the production of 38,000 tons of oilcake, from which 18,000 tons of animal feed could be produced.

33. For both the medium and the long term certain measures are being considered for the conservation and processing of animal feeds.

34. The purpose of conservation is to make feeds available at certain times when they are comparatively rare (hay storage, ensilage), and also to facilitate their use in the most appropriate forms. Conservation (storage) techniques are to be studied for brewery waste and the like.

35. As far as processing or transformation is concerned, tests are to be carried out on already familiar techniques for the enrichment of feeds. Among other things, a number of formulae for salt-licks are to be tested.

36. Two projects for additional production units are being considered in connection with the animal feed development programme:

- One unit would be situated in the region of Mutara, an area which produces a great deal of maize and which would potentially be capable of producing also soya and rice bran.

37. Moreover, this is a region which could accommodate 50,000 cattle on average to consume the animal feed thus produced.

- Another unit could be installed at Nyassibindu with a view to the eventual installation of an oilseed complex in the area, which is located in the region of Butaré; in addition to the possible production of seedcake, the region could also produce cereals, and it accommodates large numbers of cattle, pigs and poultry. The proximity of other localities such as Gikonkoro and Gitarama with large numbers of feed-consuming animals also argues for the choice of Nyassibindu as a site.

Western subregion: Mali

38. Mali is a Sahel country with an economy based largely on primary sector production: agriculture, stockbreeding and fishing.

39. In estimating the numbers of livestock in Mali, we can make the approximate assumption of one animal per inhabitant, which gives a rough figure of 9 million for total livestock.

40. Stockbreeding is prevalent in crop-growing regions and other regions exploited agriculturally, from north to south and from east to west. There are large and medium-sized undertakings as well as small family holdings. More and more individuals are moving into agriculture and stockbreeding, principally the fattening of livestock which allows profitable sales of fattened animals to the butchers.

41. All these different approaches to stock-raising require animal feed.

42. Since Mali is an agricultural country, there are numerous possibilities of finding local raw materials for the production of animal feeds, based largely on agricultural by-products, such as:

- Rice straw;
- Waste ground rice;
- Sugar cane butts;
- Sugar cane treacle;
- Cottonseed;
- Cottonseed cakes;
- Groundnut tops;
- Groundnut cake;
- Meat meal;
- Blood meal;
- Bone powder;
- Fish meal;
- Rice bran.

43. It appears from the report of Dr. Daouda Diallo (DNES/MEN) and Dr. Makan Simon Sissoko (IER/MDRE) entitled "Animal Feed in Mali: Present Situation and Future Prospects" that there are six types of animal feed in Mali which use these by-products:

1. Feeds derived from the oilseed sector;
2. Feeds stemming directly from agricultural production which undergo no processing (harvest by-products);
3. Feeds obtained directly from cereals or following the processing of cereals in agro-industrial units;
4. Animal feeds derived from the sugar sector (notably sugar cane);

5. Animal feeds derived from slaughterhouse by-products;

6. Animal feeds from the fishing sector.

44. The study cited above indicates that the oilseed sector does not provide animal feed directly but through harvest and agro-industrial by-products. This being so, we can distinguish three types of animal feed furnished by the oilseed sector:

- The defibrated cottonseed produced by CMDT;
- The groundnut and cottonseed cakes produced by the SEPAMA and HUICOMA plants;
- Animal feed properly speaking, which is produced by the mixing and conditioning operations carried out at the HUICOMA plants at Koulikoro and Koutiala.

45. CMDT (Mali Textile Development Company) is the main source of by-products for the manufacture of animal feed in Mali. Under the agriculture and livestock breeding integration programme, this Company has taken steps to make use of the by-products generated in its own area.

46. Thus, within the operations referred to above, the animal feed sector involves:

- Forage production;
- Brush hay preparation;
- Storage and use of agricultural by-products (cereal stalks, tops, rice straw);
- Utilization of cottonseed, of the HUICOMA animal feed, of treacle, and of mineral salts (salt-licks).

47. Animal feed becomes problematic in Mali during the dry season.

48. The main production factory of HUICOMA often has difficulty in meeting demand, which is on the increase.

49. This means that the quest for alternative solutions for the use of by-products, such as rice straw, is particularly important.

50. In the CMDT zone, in the region of Sikasso, experiments have been undertaken with the aim of using the residual biomass remaining after harvest as animal feeds.

51. Thus, CMDT has introduced a whole complex of agricultural products based on rice straw and other by-products available at Sikasso (Klela) and in the region of San.

III. PROPOSALS

52. These proposals are based on an analysis of the constraints observed and, above all, on the questions raised by feed manufacturers and users in Africa.

53. They are intended to cover the short, medium and long term.

The problems to be confronted

Technology and pollution

54. In Rwanda, for example, we find ourselves in a region of great population density with a habitat located on hills that are very close together.

55. What this means, among other things, is that the manufacture of components for animal feeds, such as burnt bones, leads to incidents with residents living near the site of incineration. What can be done to avoid the inconvenience caused by smoke and smell? What technology could be used - imported from abroad or designed locally?

Technology and concentrates

56. In the Central African Republic, an enclaved country, just as elsewhere in Africa, the problem of obtaining high-quality concentrates - which are generally imported and therefore expensive - is a major constraint. What can be done about this? Is the solution to delocalize the different elements of the manufacturing process and to organize processing in the subregions so as to be in a position to re-dictate prices to the feed manufacturers, or to set up concentrate factories in Africa in free zones?

Integration of animal feed and raw material production

57. In order to avoid the unfortunate effects of fluctuations in international raw material prices (notably corn and corn by-products), the question arises whether it would not be possible - in order to guarantee the quality and the availability of an important raw material such as maize - to integrate the cultivation of this product as one link in the production chain. This is what is happening with SIPRA in Côte d'Ivoire, where a 10,000-ton processing and storage silo has been set up in the production zone. Thus, for SIPRA, imported raw materials represent only 3 per cent of the feed volume and 5 per cent of the cost price.

Technology and subregional cooperation in Africa

58. The technologies used in Africa for animal feeds have been largely imported, but certain techniques have been developed in countries such as Nigeria and Ghana. These countries, which have developed commercial and technical relationships with Brazil and India, supply a large amount of small and medium-sized equipment which would be relevant to feed production. These items of equipment are being manufactured locally on an increasing scale; they are not costly, and they are well adapted to the African situation, both technically and with regard to cost.

59. We have seen cooperation launched between Benin and Nigeria in precisely this sphere.

60. Would it not be wise to strengthen this kind of technical and commercial cooperation for the development of animal feed production? It could be expected to stimulate livestock feed manufacture and eventually to lead to self-sufficiency in food production.

Price, quality and status of production undertakings

61. The animal feed production undertakings are either private enterprises or enterprises with a mixed public/private status, or State enterprises.

62. The State and mixed-status enterprises were the first to become operational in most cases.

63. These enterprises were obliged, to a certain extent, to provide animal feed of a given quality at a given price.

64. Competition with private undertakings is now becoming difficult, as in Mali for example, because the mixed-status enterprises have high production costs and tend to sell at prices which they fix themselves more or less arbitrarily. However, these prices, assuming that the right raw materials are used in the correct amounts, do not enable them to operate with a sufficient profit margin.

65. What can be done to remove this constraint? One of the questions that needs to be solved is related to the specialization of the State and mixed-status enterprises such as HUICOMA in Mali, which produces oil and soap on the basis of cottonseed. These enterprises could sell the by-products of their main production line to private manufacturers of animal feed. These by-products would constitute a part of the raw materials needed. This approach would make it possible to develop the production of animal feed in enterprises belonging to the private sector with the use of appropriate technology and to obtain - through the workings of competition - a product of superior quality at a reasonable price.

Short-term proposals

66. In the light of the different questions which have arisen in the course of discussions in the various countries visited, it seems reasonable to make the following short-term proposals:

- Arrange for regular information on the utilization of animal feeds and opportunities for profitable production of such feeds.

67. The information required will be determined by the nature of the relevant markets on the national and subregional plane. It should show potential promoters how to set up small, medium and large units by providing them with relevant technological information (regarding sources of material, costs, availability), information on financing, know-how and technical partnerships, and on the availability of raw materials and by-products (sources, locations, conditions for procurement), as well as opportunities for subregional cooperation.

68. This information should be organized every year in each country, and every other year in one country of a subregion whose member countries may be contemplating collaboration. The subregion information could be obtained through the holding of an agricultural fair, which would provide information among other things on stockbreeding, poultry breeding and fish farming. Such fairs should be sponsored by the feed producers, the providers of technology and potential partners from North and South.

69. Moreover, to accelerate the creation of small and medium-sized industries in the animal feed subsector, investment promotion round tables should be held in connection with these fairs every two years.

70. For the benefit of Governments and societies which might be among either existing or potential promoters, a specialized magazine for agriculture, livestock raising, forestry and fishing is to be created under the auspices and with the sponsorship of the chambers of commerce, of agriculture and of industry. This magazine will be run on a private basis and might be able to obtain subsidies and institutional support from the African Development Bank (ADB), The West African Development Bank (WADB), the Inter-American Development Bank (IADB) and the World Bank.

71. The magazine could well appear semi-annually.

Medium- and long-term proposals

72. For the medium and long term, our proposals relate to quality control, strengthening of inter-African cooperation, and the manufacture of equipment for animal feed production with a strengthening of existing plant and the installation of new large-scale plant to assemble semi-finished imported elements obtained under the delocalization scheme from countries of the North, principally, but also from the South (Brazil, India).

73. In the medium and long term Africa could consider the installation of plants for concentrate manufacture.

74. These plants would be installed in each subregion: east, centre, western forest land and the Sahel. They would be private plants with mixed participation of businessmen from the subregion concerned and from Africa as a whole, and of technical sponsors/partners from abroad.

75. The goods produced by these factories would be bought by animal feed manufacturing units in the countries of the subregion - with priority - and in Africa as a whole.

76. In the medium term, therefore, in other words from 1992 until 1997, the aim should be to promote the establishment of medium-sized manufacturing units, the specific nature of each unit depending on the raw materials available in the various zones.

77. These small and medium-sized units would replace existing cottage industry. There is really no alternative to this, as they would yield products of better quality.

IV. PRIORITY TOPICS AND MEASURES

78. It is important that UNIDO should be able, in the context of the second industrial development decade which is now beginning, to take those actions which are most consistent with the foregoing proposals. This being so, the following recommendations could help in identifying priority measures.

Strengthening and/or establishment of efficient production units

79. It would be desirable to consider the establishment of a committee or task force for follow-up purposes. The committee would be composed of independent professional consultants with training as industrial economists, agricultural economists, veterinary economists and so on, and would have the following tasks:

- To make a list of all existing units that require "rehabilitation" and to register the projects which are being set up in the different countries. These new projects should be those which have already been the subject of a feasibility study and which are seeking appropriate technology and financing;

- To help new and old projects to get going with appropriate injections of financial support, relying to some extent on funds from the ADB, the WADb, the IADB and the Economic Community of West African States;

- To determine where subregional units for concentrate production are required (transnational enterprises) and to help set them up;

- To determine where subregional units for the manufacture of equipment for animal feed production are needed and to help set them up, beginning with equipment assembly units and subsequently going on to complete units manufactured locally.

Marketing and information

80. The measures which are to be given priority must be based on regular, carefully targeted information supplied by each country once a year.

(a) The first step is to identify the raw materials which are available in sufficient quantity in the different regions and to set up an exchange and compensation centre which would enable small and medium-sized enterprises to continue production without any interruption in the supply of raw materials, using quality input in the form of by-products, concentrates and so on;

(b) In order to enhance the demand for locally produced feeds, it will be important to invest substantial efforts in a popularization programme, relying among other things on demonstrations; it is also particularly important that the product should be available in the vicinity of prospective users once the essential advertising has been done.

81. At the same time, steps should be taken to secure high-quality animals to make effective use of the concentrate and improve the income of stock raisers; and this would also naturally increase their ability to purchase the feed.

Quality control

- Attention must be given to identifying measures and rules by which the quality of commercially feeds can be certified.

- With regard to feed manufacture, it would be important to organize a well-equipped laboratory which can perform chemical analyses of raw materials to assess their nutritional value. After manufacture, therefore, the feeds should be tested to evaluate the response of the animals consuming them, and controls and checks should be organized by an official body in order to protect users against any abuse on the part of the manufacturers.

82. To sum up, then, the laboratory (national or subregional) would perform measurements and analyses on every product described as animal feed (concentrates, forage, and agricultural and agro-industrial by-products).

Quantitative enhancement of local raw material inputs

83. For the long term, effective steps must be taken to secure an integrated development of local raw material production for animal feeds, in order to minimize the price of the final product by reducing the input costs (for concentrates, local raw materials and so on). The relatively low cost of locally produced equipment would also be a help in this respect.

84. This work should be carried out in parallel with other agricultural development projects: rice, maize and soya projects, as well as fishing, forestry and so on.

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STRUCTURE AND PROBLEMS OF NIGERIA'S ANIMAL FEED INDUSTRY

Information paper*

Prepared by

Basil U.N. Igwe
UNIDO Consultant

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A B S T R A C T

Notwithstanding Nigeria's sizeable livestock population (cattle, goats, sheep, pigs and domestic and exotic poultry), the country is still deficient in animal protein consumption. In fact, the average daily intake per capita amounts to only about 38 per cent of the minimum value recommended by the Food and Agriculture Organization (FAO) for the developing countries. As a consequence, such protein-deficiency-related diseases as kwashiorkor still persist and may in fact be intensifying, particularly among children and the rural and urban poor.

Although poultry provides only about 10 per cent of the national meat consumption, it is the most modern and technically developed element of livestock husbandry. Accordingly, 95 per cent of the compound animal feed production is targeted at the poultry industry. At present, there are about 10 large-scale feed mills, i.e. 10 tons/hour and over, and fewer than 100 small- and medium-scale mills, most of which are located on poultry farms and are rated at under 2.5 tons/hour. The total feed output declined from about 500,000 tons in 1985 to under 200,000 tons in 1991.

Among the constraints militating against increased output are the inadequate availability of raw materials from both domestic and foreign sources, the industry's traditional resistance to utilization of non-conventional alternative ingredients, the inability to recover and process agricultural and industrial wastes for use in feed manufacturing, and the national over-dependence on imports for machinery, equipment and spare parts.

Several local alternative ingredients have been identified. Among these are sorghum, millet, cassava, yam, oil palm products, periwinkle shells, rubber seed, sugar cane tops, molasses and elephant grass. However, appropriate processing technologies and equipment need to be developed for rendering many of them suitable for use in commercial feed formulation.

For sustained long-term development of the industry, several specific strategies and actions are recommended. These include:

- Establishment of a macro-economic policy environment conducive to stimulating private sector and small-scale investments in both poultry farming and animal feed manufacturing;
- Expanded production of the key crops and ingredients consumed by feed mills;
- Development (through research and plant breeding) of specialized and end-user-targeted hybrids of feed mill crops to minimize the competition with human and other industrial consumers;

- **Enhanced recovery, processing and utilization of non-conventional agricultural and industry by-products;**

- **Development of the local capital goods and engineering industries for the supply of machinery, equipment, spare parts and maintenance services; and**

- **Establishment of strategic grain reserves to serve as a buffer against production fluctuations.**

I. THE NIGERIAN LIVESTOCK SUB-SECTOR

1. The economic importance of the livestock sub-sector may be gauged from the fact that, according to the Central Bank of Nigeria, it contributed about 5.9 per cent of the Gross Domestic Product (GDP) in 1989, representing over 20 per cent of the agricultural GDP. Furthermore, the sub-sector traditionally provides employment and income to a substantial proportion of the rural population.

2. Its economic importance notwithstanding, the sub-sector is still unable to satisfy the minimal recommended animal protein requirement of the average Nigerian. For instance, whereas the British Medical Association's recommended minimum protein intake per day capita is 34 grams, and the Food and Agriculture Organization (FAO) of the United Nations recommends a minimum intake of 20 grams/capita/day for the developing countries, the figure for the average Nigerian stood at only 7.6 grams in 1985, equivalent to 38 per cent of the FAO recommendation. The economic difficulties engendered by Nigeria's Structural Adjustment Programme (SAP) have probably driven that figure further downwards.

3. Nigeria's livestock population consists largely of cattle, sheep, goats, pigs and poultry. A 1990 census by the Federal Department of Livestock and Pest Control Services yielded the following population estimates:

Cattle	-	13.9 million
Goats	-	34.5 million
Sheep	-	22.1 million
Pigs	-	3.4 million
Indigenous poultry	-	102.8 million
Exotic poultry species	-	46-49 million

In terms of meat supply, however, cattle contribute over 50 per cent of the national consumption. Sheep and goats account for about 35 per cent while poultry contributes only 10 per cent.

4. The constraints militating against optimal performances by the Nigerian livestock sub-sector can be categorized as technical, sociological, economic and institutional.[1] The technical constraints are those conventionally associated with traditional pastoralism and the prevalence of the culture of subsistence animal husbandry. These give rise to inadequate nutrition, diseases, high mortality and poor genetic potential of indigenous animal species. The sociological constraints derive from ancient cultural values associated with livestock. These tend to impede the adoption of new technologies and production practices. The economic problems are manifested in the form of limited or

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[1] S. Tunji Titilola, "The Nigerian Livestock Sub-Sector and Prospects for the Future," Proceedings of the Workshop on the Proposed Livestock Sub-Sector Review, LIMECU, April 1992.

inaccessible farm capital and credit, inadequate infrastructure and poor pricing of livestock products. As for the institutional constraints, these are in the form of poor extension services, in inadequate human capacity building facilities and inefficient marketing systems.

5. Of the various components of the livestock sub-sector, the poultry industry experienced the fastest growth and dynamism in the last twenty-five years. Introduced commercially in the late-1990s, modern poultry farming experienced only a modest development until about 1974. This was followed by an impressive boom between 1974 and 1983. During this period, the domestic supply of poultry meat from exotic species alone increased from 8.1 per cent in 1977 to 11.4 per cent in 1987. However, since 1987, the industry has been in relative decline. About 80 per cent of the modern poultry farms in operation in 1983 have since closed down, and no new projects are being brought on-stream at present.

6. Among the factors contributing to the current depressed status of the industry are:

- The limited availability and concomitant high cost of poultry feeds;
- The high level of dependence on imports for poultry equipment, spare parts and drugs; for instance, whereas in the early-1980s, it cost about three Naira (N3) per bird-space of cage, the corresponding early-1992 price was over N70.
- Poorly developed infrastructure, particularly water and electricity supplies in the rural areas where poultry farms are located in order to avoid pollution of the urban environment; as such, most poultry investors must, in addition to conventional productive facilities, invest in such apparently extraneous items as access roads, electricity generators and water boreholes.
- Bad poultry management attributable to the general lack of appreciation of poultry husbandry as a specialized discipline.

II. THE ANIMAL FEED INDUSTRY

7. A survey by the Nigerian Institute of Social and Economic Research (NISER) indicated that there were about 440 feed mills in Nigeria in 1986, with an aggregate production capacity of about 1,500 tons of feed per hour.[2] Of these, about 95 per cent could be categorised as small-scale in the sense that their rated

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[2] M.S. Igben, V.A. Adeyeye, S.O. Akande and P.A. Okuneye, "The Raw Materials Crisis in Agro-Allied Industries in Nigeria: Magnitude, Prospects and Strategies," NISER Technical Report, 1987.

capacities were less than 10 tons per hour. In fact, 60 per cent of the total number had individual capacities well under 2.5 tons per hour.

8. In terms of installed capacity utilization, the trend during the 1975 to 1988 period was as follows:

Year	Installed Capacity	Utilised Capacity
1975	500,000 tons	250,000 tons (50%)
1978	680,000 tons	350,000 tons (51.5%)
1985	1,000,000 tons	500,000 tons (50%)
1987	850,000 tons	310,000 tons (36.5%)
1988	650,000 tons	169,000 tons (26%)

The 1992 effective installed capacity and capacity utilisation are believed to be even lower than the 1988 figures.

9. The above figures should be assessed against the estimated demand figures of 850,000 tons and 825,000 tons for 1989 and 1991 respectively, in order to appreciate the severity of the supply short-fall as well as the astronomical dimensions of the escalation in feed prices in the last eight years. What is even more disturbing is that, in order to meet the animal protein needs of the Nigerian population in the year 2000, the annual output of livestock feeds would have to be in range of 2.6 to 3.5 million tons.

10. The demand pattern for compound livestock feeds is currently estimated to be as follows:

Poultry	-	95%
Pigs	-	3%
Cattle	-	1.5%
Others	-	0.5%

11. Non-availability of feed ingredients is the single most important factor responsible for the industry's under-utilization of installed capacity. This has been further exacerbated by the extreme conservatism of the local industry which has traditionally depended on only a limited choice of well-tested raw materials such as maize, groundnut cake and fish meal, and has consistently shied away from utilising alternative local ingredients.

12. Furthermore, certain government policies and measures introduced as components of the Structural Adjustment Programme (SAP) have had the adverse effect of restricting raw materials availability from both local sources and imports. Insofar as domestic production is concerned, the lifting of controls on producer prices and the abolition of the Commodity Marketing Boards in 1986 resulted in a sudden drastic price escalation to which the farmers reacted by substantially increasing production in the following year. With the resultant surplus production,

prices plummeted. Subsequent years have witnessed this cycle of surplus-followed-by-deficit, as well as severe price fluctuations for such grains as maize, soya bean and groundnut. With respect to importation of feed ingredients the Government in 1986, in an effort to improve the country's balance-of-payments position and stem the massive drainage of foreign exchange, imposed a ban on the importation of most grains, including wheat, maize, rice and barley malt. It had been hoped that this would stimulate local production and ultimately stabilize prices. It is doubtful whether any of these objectives have been achieved. In fact, the ban on wheat importation which encouraged massive smuggling from other countries in the sub-region, has recently been lifted. In the meantime, local production hardly increased and the prices may never again return to their pre-SAP levels. The severity of the price escalation for feed ingredients can be seen from the following:

Ingredients	Pre-SAP Price (per ton)	April 1992 Price (per ton)
Local maize	N400 - N500	N 3,200
Soya bean meal	N 450	N 4,200
Groundnut meal	N 550	N 3,600
Bone meal	N 200	N 800
Imported fish meal	N 800	N 3,000
Imported lysine	N10,000	N62,000

The upward price spiral was further fuelled by the competition for grains between human consumers, the feed mills, breweries, flour mills and pharmaceutical manufacturers. This was a competition which the feed mills were ill-equipped to win since they do not normally enjoy the quicker turnovers, consumer loyalty, capacity to pass on cost increases, high return-on-investment and greater price stability characteristic of the other industries.

13. The feed mills might have been able to weather these cost escalations had they been more favourably disposed towards utilization of more readily available alternative ingredients. For instance, whereas maize is used at levels of 40 - 50 per cent in Nigerian livestock feeds, research has demonstrated that poultry formulations containing only 20 per cent maize could be effective and economically efficient. The long-term consequences of such a modification are even more impressive and far-reaching. The maize requirement of the livestock feed industry in the year 2000 could thus be reduced by 60 per cent from 5.3 million tons to only 2.1 million tons.

14. In addition to reducing the maize utilization level, such local crops as sorghum, millet, cassava and potato chips, rice polishing waste, maize offal and dried brewers' grain could be readily substituted for maize in poultry feeds without a severe loss of nutritional effectiveness. The substitution of cassava for maize is of particular interest as Nigeria is the world's largest producer at about 13 million tons per year, of which about 700,000 tons is potentially available to the livestock feed industry.

15. Other possible substitutes that would relieve the demand pressure on maize, most of which is for human consumption, are maize-cum-full fat soya bean or poultry offal meal in place of fish meal, and cotton and sunflower seed cake as a replacement for soya bean meal. With respect to cotton seed cake, indications are that the problems of gossypol toxicity and mycotoxin retention in animal tissues may be unduly exaggerated.

16. As stated previously, feed milling in Nigeria is virtually synonymous with the production of poultry feeds. As such, most small-scale feed mills are located on poultry farms and have capacities in the 0.5 to 1.0 ton per hour range. This size is ideal for a 20,000-bird poultry farm. The feed manufacturing technology involved is relatively simple and straight-forward, consisting merely of grain milling, mixing in of appropriate concentrates and packaging, usually in bags.

17. A typical 0.5 ton per hour mill would comprise the following principal elements:

- hammer mill
- stone trap and magnet for removing impurities from the hammer mill
- intake hopper with grate to control flow
- vertical mixer
- dust sack
- bagging-off chute.

18. The hopper is generally mounted at such an angle as to facilitate the free flow of the grain. A sliding gate at the neck of the hopper controls the rate at which the grain enters the mill. Generally, a screen with 3.0 millimetre holes is employed and the milled grain is usually pneumatically discharged into the top of the mixer. An auger delivers the concentrate which has been loaded by the operator into the mixer where it is mixed with the grain and delivered into a bag chute. Most of the feed mills are fitted with dust bags and the recovered dust is generally recycled.

19. Many of the equipment elements of a small feed mill of the type and size described above can be locally fabricated. The working parts of the hammer mill, the screen and the hammers are easy to replace from local fabricators. In fact, the following institutions have developed more or less proprietary designs of small-scale feed mills that have been fabricated, installed and are satisfactorily operating in several poultry farms around the country:

- Projects Development Institute (PRODA), Enugu
- Rural Agro-Industrial Development Scheme (RAIDS), Ibadan
- The Directorate of Food, Roads and Rural Infrastructure (DFRRI), Lagos
- The African Regional Centre for Engineering Design and Manufacturing (ARCEDEM), Ibadan
- The Federal Institute of Industrial Research, Oshodi (FIIRO), Lagos

- The Faculties of Engineering and Technology of several Universities and Polytechnics, including the University of Ibadan, the Obafemi Awolowo University, Ile-Ife, the University of Nigeria, Nsukka and the Ahmadu Bello University, Zaria.

20. Insofar as international trade in animal feeds is concerned, there does not now appear to be any significant legal regional or sub-regional activity involving Nigeria, although there may be some smuggling to and from the neighbouring countries. However, given the fact that Nigeria possesses vast, albeit largely untapped potentials for local production of many of the key feed mill ingredients such as maize, soya bean, groundnuts and sorghum, and given its national installed grain milling capacity of about 4.2 million tons per year from 22 large-scale mills, there is reason for optimism regarding the eventual evolution of some significant trade in animal feeds within the Economic Community of West African States'(ECOWAS) sub-region. This is a subject that should attract the interest of Nigerian and ECOWAS policy-makers at this time of increasing emphasis on the promotion of regional trade in non-oil manufactured exports.

21. In summary, the major constraints militating against the growth of the livestock feed industry in Nigeria include:

- Irregular and inadequate supplies of raw materials;
- High and unstable prices of feed ingredients;
- Inability to recover, process and utilize local agricultural and industrial by-products and wastes;
- Reluctance of the industry to utilize alternative ingredients;
- Dearth of information on the composition and processing requirements for locally-available ingredients, by-products and wastes;
- Inadequate technical and managerial expertise;
- Inadequate and inefficient infrastructure and utilities;
- Over-dependence on importation for machinery, equipment and spare parts due, in large measure, to the underdeveloped status of the local capital goods and engineering industries; and
- Instability and unpredictability of government policies.

III. ALTERNATIVE FEED INGREDIENTS

22. Recognizing the need to reduce the industry's over-dependence on scarce cereals and to minimize or, if possible, eliminate such expensive imported feed components as fish, bone and meat meals, the current Government-motivated policy is aimed at exploiting all locally-available alternative feed ingredients. Alternative feed formulations would desirably contain such locally-available by-products as brewers' grains, dried brewers' yeast, palm oil sludge and molasses from sugar manufacturing. Potential alternatives to fish meal which, in any event, could be locally-produced from trawling discards, small-sized clupeids and fish offal, include poultry offal meal, blood meal and sterilized and dried poultry

manure. As for the minerals, locally-available periwinkle shells and limestone could be substituted for such conventional ingredients as bone meal and oyster shells.

23. In the wake of the collapse in the late-1980s of the poultry and feed industries, the Government in 1989, set up a Presidential Task Force on Alternative Formulations of Livestock Feeds.[3] The membership of the Task Force was drawn from academia, relevant government ministries and agencies, the livestock and feed manufacturing industries, and animal and food research institutions. Its broad mandate was to analyze the raw material problems of the animal feeds industry and to identify, test and recommend alternative ingredients for use in feed formulation, giving substantial weight to maximum utilisation of local ingredients. In discharging this mandate, the Task Force conducted elaborate surveys, chemical analyses of identified potential alternatives, and formulated and tested feeds with poultry, pigs, rabbits, cattle, sheep and goats.

24. On the strength of these analyses, the following documents were produced and published for dissemination to interested feed manufacturers, farmers, investors and researchers:

- Feed compositions, feed resources utilisation and economics of use of non-conventional and industrial by-products;
- Validation results on nutrient requirements of various classes of livestock and fish;
- Processing technologies and fabrication of small and medium-scale equipment for farm products;
- A compendium of 2,500 alternative diets for non-ruminants, 40 alternative diets for dry-season supplementary feeding of ruminants, and 20 alternative simplified diets for broilers, layers and fish.

25. More specifically, the Task Force identified the following local feed resources:

i. Cereals and by-products
Maize; sorghum; millet; rice; wheat; dried brewers' grain (DBG); bran; husk and offal.

ii. Carbohydrate ingredients
Cassava; yam; cocoyam and potatoes.

iii. Mineral sources
Periwinkle and oyster shells; limestone.

iv. Oilseeds and by-products
Beniseed; sunflower; oil palm products; cashew; cottonseed; groundnut; soya bean; rubber seed; melon seed and cowpea.

[3] Report of the Presidential Task Force on Alternative Formulations of Livestock Feeds, October 1992.

v. Protein sources
Shrimp heads; poultry offal; animal blood.

vi. Roughage materials
Sugar cane tops; elephant grass; sweet potato vines.

26. Recommendations were also made for specific measures to be taken by both the Government and the industry for increased utilization of the identified ingredients which should ultimately lead to lower prices for animal feeds. For the industry, the recommendations included a greater role in ingredients production. This would not necessarily involve direct production, but could be through such indirect measures as promoting out-grower schemes for the major feed crops, supplying credit, inputs and extension services to small- and medium-scale farmers, and shifting emphasis from finished feed production to high-quality feed concentrates. The Government, for its part, would implement programmes for increased crop production, and would set up a chain of Livestock Feeds Monitoring, Research and Development Centres for feed quality control and monitoring, screening of feed ingredients, and enforcement of standards in feed formulation.

IV. RECOMMENDED STRATEGIES FOR SUSTAINED DEVELOPMENT

27. As is evident from the foregoing, the structure and constraints of the Nigerian animal feeds industry are such as can only be effectively addressed with a comprehensive and multi-dimensional package of policies and actions. This would necessarily require the involvement of the Government, the feeds manufacturing industry and researchers. The following specific recommendations point to the types of action and programme required for future sustained development of the sub-sector:

(a) Creation of a favourable macro-economic policy environment

The macro-economic policies that most directly affect the livestock and animal feed industries and which could be fine-tuned to harmonize with increased production and efficiency, are fiscal policy (i.e. public expenditure, investment policies and taxation), monetary policy (i.e. interest rate and credit guidelines), exchange rate policy, external trade policy and public sector reform which could conceivably involve such measures as commercialization and privatization of erstwhile public enterprises.

(b) Production expansion of key ingredients

Since farmers and other investors base their behaviour on the potential returns on their investment and labour, any programme for expanded agricultural production should be rooted on a realistic appraisal of the factors that determine this behaviour. In this connection, past Government-driven production expansion programmes such as the Accelerated Food Production Programme, Operation Feed-the-Nation, the Green Revolution and the Accelerated Wheat Production Programme, largely failed because they were ill-planned and ill-

supported with the necessary resources, politically motivated and often not founded on the tenets of the market. Future programmes should learn from the experience of the past and should make full use of existing institutions such as the various state Agricultural Development Projects (ADPs), the River Basin Development Authorities (RBDAs), the National Agricultural Land Development Agency (NALDA) and similar organizations.

(c) Development of specialized and user-targeted hybrids of key crops

This is significant in view of the fact that the acknowledged limited outputs of maize, sorghum, soya beans and millet must be competed for by human and industrial consumers. There is, for instance, no genetic differentiation between maize for human consumption and maize for livestock feed mills. There is therefore a need for expanded research aimed at developing hybrid species of the various crops for targeted end-use markets. This would minimize competition and moderate prices.

(d) Enhanced utilization of non-conventional domestic feed ingredients

These have already been identified. Unfortunately, virtually all of them require some measure of pre-processing, either at the source or at the point of use. This calls for the development of appropriate processing technologies and equipment.

(e) Development of the local capital goods and engineering industries

The weakness of these sub-sectors has been the bane of the Nigerian industrial sector in general, contributing significantly to the gross under-utilization of installed manufacturing capacity. Because machinery, spare parts and technology cannot be readily sourced locally, there is an over-dependence on importation. The sustainable solution lies in fostering the development of the local engineering and capital goods industries, and in technical manpower development to meet the needs of industry, including animal feed.

(f) Strategic grains reserve

Given the cyclical nature of production of many of the key crops consumed by feed millers, there may be advantages in establishing a National Strategic Grains Reserve as a measure for buffering temporary shortages and moderating price fluctuations while ensuring reliability of supplies to industrial end-users such as feed mills.

(g) Local production of feed supplements

This is crucial if the industry is to achieve a greater measure of self-reliance and enhanced value-added in manufacturing. What is more, the drastic price increases on imported inputs arising from the SAP-dictated devaluation of the Naira would have been ameliorated had there been a credible local supplements manufacturing industry based largely on local raw materials.

(h) By-products recovery and processing

As pointed out previously, many agricultural and industrial by-products that could be consumed in animal feed production are currently wasted. Measures are required for ensuring their recovery and pre-processing for use. For instance, animal blood and bone are routinely wasted at the local abattoirs and slaughter-slabs while, ironically, costly blood and bone meal are imported for feed production.

REFERENCES

1. S. Tunji Titilola, "The Nigerian Livestock Sub-Sector and Prospects for the Future", Proceedings of the Workshop on the Proposed Livestock Sub-Sector Review, LIMECU, April 1992.

2. M.S. Igben, V.A. Adeyeye, S.O. Akande and P.A. Okuneye, "The Raw Materials Crisis in Agro-Allied Industries in Nigeria: Magnitude, Prospects and Strategies", NISER Technical Report, 1987.

3. Report of the Presidential Task Force on Alternative Formulations of Livestock Feeds, October 1992.

4. Proceedings of the National Conference on Prospects for Livestock Development in Nigeria, NISER, Ibadan, November 1990.

5. CBN/NISER National Study on the Impact of SAP on Nigerian Agriculture and Rural Life", January 1992.

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STATE OF ART AND PROBLEMS OF THE ANIMAL FEED PRODUCTION INDUSTRY IN ZAMBIA

Information paper*

Prepared by

Moses T. Daura
UNIDO Consultant

* The views expressed in this document are those of the author and do not necessarily reflect the views of the Secretariat of UNIDO. Mention of firm names and commercial products does not imply the endorsement of the United Nations Industrial Development Organization (UNIDO). This document has not been edited.

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I. INTRODUCTION

1. Zambia's human population grew by about 3.2% a year over the past two decades, but the amount of food it produced only increased slightly. Therefore, each person in Zambia on average has less food now than 20 years ago. The food situation is worse this year because of the severe drought that affected the whole of the southern African region. The outlook is even grimmer for the supply of food-related livestock products. The annual stock for sale this year rose sharply, outstripping the herd and flock growths as people sold their animals and poultry for fear of them dying due to lack of food and water as result of the drought. The current levels of saleable animals stock are thus unsustainable unless these can be re-stocked and flock/herd productivity increased.

2. Livestock plays a variety of economic and social roles in Zambia. They provide high quality food outputs (milk, meat and eggs) for consumption at home or sale in the market place, inputs into crop production (manure, draught power), transport and household fuel supplies, and other non-food outputs (hides, skins and fibres for making a variety of household products). Sales of livestock and their products raise cash for their owners to buy what they cannot produce themselves, such as fertilizers and seeds needed to increase crop production. Because livestock grow in number and in individual size, they also constitute a form of investment and security in which savings can be kept and drawn on in time of need. In some societies of Zambia, livestock ownership also provides prestige. Therefore, Zambia's livestock subsector is important.

3. The most valuable output of livestock is meat, accounting for 47% of the total value of all food-related livestock products, while milk is value at 14% (International Livestock Center for Africa, ILCA, 1990). People in sub-Saharan Africa eat little meat - an average of about 10 kilograms per person per year, compared with over 80 kilograms per person per year in Europe (ILCA, 1990). In general, this reflects the small amount of meat produced in the region. Between 1974-76 and 1986-88, per capita meat production in Africa declined by 0.7% per year, while consumption increased by only 0.1% per year (ILCA, 1990). In the mid 1970s, when livestock feed production and quality were at a peak in Zambia, the average consumption of marketed meat was about 8 kilogram per person per year (Liteta and Ngulube, 1991), a figure lower than the average for the sub-Saharan African region. Poultry accounted for about 48% of this. Between 1976 and the early 1980s, poultry production, which was the best performing section of the livestock subsector, declined at a rate of about 4% per annum (Liteta and Ngulube, 1991), leading to an even lower meat consumption per person per year. Present egg production represents 39 eggs per person per year (Liteta Ngulube, 1991). This shortage of animal protein in people's diets leads to malnutrition and consequently predisposes children to increased susceptibility to disease, slow growth, mental retardation and sometimes death. Schlesinger and Stekel (1973) observed that the whole immunological mechanism is altered after a prolonged period of malnutrition.

4. Livestock could play a much more important role in increasing Zambia's home grown food supplies and the provision of high quality protein to combat the existing calorie/protein imbalances in people's diets, but the livestock subsector is plagued by technical, social, economic and institutional problems. Among the more serious technical constraints is poor nutrition, which is commonly regarded as the main limitation to livestock performance in sub-Saharan Africa (ILCA, 1991), and central to this are inadequate and erratic supplies of good quality (digestibility and protein content) animal feeds.

5. This paper examines the state of art of the animal feed production industry in Zambia. The major constraints affecting the industry's performance are highlighted and recommendations on how these can be overcome are suggested.

II. THE ANIMAL FEED PRODUCTION INDUSTRY - PAST AND PRESENT

6. The total animal feed market in Zambia is estimated at 140,000 tons (Lee, 1991); with the poultry sector being the major compound feed user (about 80% of the feeds produced), followed by the pig sector (12%), and the cattle sector (6%). The product categories include broiler (starter and finisher), chick, growers, layers and breeders mash for poultry; pig creep, pig grower and sow meal for pigs; calf and dairy meal for dairy cattle. The feed for dairy cattle cannot all be classified as compound feed as much of it are simple mixtures without premixes added. Similarly, beef cattle feeds cannot be classified as compound feeds although a compound feed, high energy beef meal, used to be made in the 60s through the mid-80s. Others include horse feeds, laboratory animal feeds (e.g. mouse comproids) and rabbit pellets. Turkey feeds and other types of poultry feed may be produced on request.

7. Up to the late 1980s, about 70% of the stock feeds produced and marketed in Zambia were produced by a parastatal corporation's (Industrial Development Corporation, INDECO) subsidiaries: National Milling Company Ltd. (NMC), Indeco Milling Ltd. (IML), and E.C. Milling Ltd. (ECM), now Amalgamated Millers, (AML). The remaining 30% was produced mainly by the Zambia Agricultural and Trading Company Ltd., Jamas Milling Company, Chimanga Changa Ltd., and Kabwe Milling, all parastatal companies. The parastatals' monopoly of the stock feed market ended in 1989/1990 with the entry into the business by two private companies: Nshima Milling and Soy Nutrients. Some farmers and private poultry breeding companies mix stock feeds for their own use and their contribution to the total stock feed production is estimated to be about 30%.

8. Most of the stock feed producing plants in Zambia are located along railway lines thus most of the livestock farming, especially poultry, is confined to the Lusaka, Central, Copperbelt and Southern provinces, which are served by the railway line. The confinement of stock feed production plants to the four provinces leaves great potential for growth in livestock production yet to be exploited in the remaining five provinces of the country if stock feeds could be made available there.

9. Stock feed production in Zambia was a flourishing industry in the 1960s and 70s. This was mainly because the country had enough foreign exchange to import sufficient quantities of animal and vegetable proteins and other ingredients for use in the compounding of animal feeds. As such, 90% of the protein ingredients and all of the vitamins and minerals were imported. Because the imported ingredients were of good quality, the quality of the stock feeds produced was high. The other reasons the stock feed industry did well are that the plants and machinery were fairly new and in sound shape, and that the costs of raw materials and other production inputs such as energy, transport and other production overheads were fairly predictable (Chacko, 1990).

10. Over the last decade the situation has changed for the worse. There is no foreign exchange to import sufficient quality raw materials, stock feeds are produced in old plants whose output capacity has been greatly reduced (most plants operate at below 50% capacity utilization, Musenge, 1990), and the industry depends largely on locally-produced vegetable proteins such as

soya beans, sunflower and cottonseed cake which are not only available in insufficient quantities, but are also of poor quality. Table 1 highlights the trend in stock feed production since 1980.

III. SOURCES OF RAW MATERIALS

11. Supply of, and demand for stock feeds change depending on the quality, quantity, price and distribution of the stock feeds on one hand and livestock on the other. The two areas are interdependent in such a way that if one area suffers the other gets affected as well. As the trend in stock feed production for the past decade indicates (table 1), the drop in stock feed production from levels of about 192,000 tons to about 140,000 tons per year imply that some livestock farms, especially poultry, were closed completely or there were cut-backs in the herd or flock sizes to adjust to the stock feed supply situation.

12. Many farmers have in the past purchased feeds on the basis of price per ton, and many still do. This has in fact in the past often been the right procedure in order to obtain the maximum profit because the quality of the feed was high. Today the situation is quite changed. The emphasis is now on quality as this fluctuates greatly depending on the availability of good quality raw materials. There is ample evidence that maximum profit is obtained by the use of high quality feeds. Purchase of livestock feeds on the basis solely of price per ton is now an obsolete method of training (Lee, 1991). Zambia is fortunate in that it has the potential to be self-sufficient in supplying the main feed ingredients and only needs to import specialized additives such as premixes and drugs. This means that potentially over 90% of the feed cost is local component which is highly favourable for livestock development in the country.

13. Feed ingredients used in formulation of stock feeds are classified into four major categories:

(i) Energy sources
(ii) Protein sources
(iii) Minerals and vitamins
(iv) Additives.

14. The major ingredients that constrain feed compounding are the energy and protein sources.

Energy sources

15. Maize, millet, sorghum, barley and oats are the major cereal grains used in animal feed production. Occasionally, surplus or damaged wheat, if lowly priced to compete with these coarse cereals, is used in poultry rations. In some cases broken rice is included in animal feed rations.

16. In Zambia, maize and its by-products comprise the main source of energy feeds. A total of 90,000 - 100,000 tons of maize and its by-products is required annually by the stock feed industry. The allocation of maize for stock feeds is secondary to the needs for human consumption as maize (white) is also the staple food in Zambia. Therefore, yellow maize would be preferred for stock feed production. However, very little yellow maize is grown in the country. For instance, in 1989/90 season the three stock feed plants under INDECO could procure only about 5,000 tons of yellow maize against the total of 30,000 tons it required.

17. Sorghum, millet and cassava are crops grown in the country that can be used as energy sources in stock feeds, but these, though produced in amounts large enough for them to be used in commercial quantities for stock feed production, are retained by farmers for use in the homes (see table 4), mostly for brewing local beer for sale.

18. Maize No. 3 meal is the by-product produced during the manufacture of breakfast meal. Up to 45,000 tons may be produced and this is enough to meet the country's annual requirement for this product for stock feed production.

19. Maize and wheat bran, because of their high fibre content, are of limited use for poultry feeds and thus are available in excess. These are extensively used by cattle farmers.

Protein feeds

20. Protein feeds used in the compounding of stock feeds include animal and plant proteins. Animal protein sources include fish meal, meat meal, meat and bone meal, blood meal and chicken offal meal. Only minimal amounts of animal proteins are available in Zambia. Vegetable protein in the form of oil cakes is the main source of protein. Soya bean meal, cottonseed meal and groundnut meal represent the major plant protein supplements used in stock feeds. Other plant protein supplements are decorticated safflower seed meal, sesame seed meal, sunflower meal and coconut oil meal. In Zambia, the available plant proteins are soya bean meal, cottonseed meal and sunflower seed meal. These are either solvent extracted or mechanically expelled. The preference is for solvent extracted as this represents cakes of high quality in both protein and fibre content and the process easily gets rid of anti-nutritional factors present in some.

21. Plant proteins however are generally deficient in methionine and lysine and this limits their use especially in poultry diets (Scott et al., 1976). The essential amino acids of soya bean meal and maize proteins complement each other but for sulphur amino acids and lysine. These deficiencies can be rectified by supplementing with crystalline amino acids.

22. Oil seed meals or cakes available in Zambia for producing stock feeds are the by-products of oil extraction or dry extrusion processes. Oil extraction methods employed come under two categories:

(a) Solvent extraction, with or without decortication (soya bean, sunflower and cotton seeds);

(b) Mechanical extraction, with or without decortication (soya bean, sunflower and cotton seeds).

23. Dry extrusion is used for soya bean processing in order to produce full fat soya. In this method oil is not extracted.

24. The stock feed industry's requirement for oil cakes and the production of oil seeds for the 1989/90 season are given in table 2. From this table, it is evident that only cottonseed cake is produced in sufficient quantities to meet its requirement for commercial stock feed production.

Soya bean cake

25. The stock feed industry prefers solvent extracted soya bean cake because of its high quality. Processing of full fat soya for stock feeds is quite delicate. Undercooking results in a product with high levels of anti-nutritional factors such as trypsin inhibitors and overcooking reduces protein availability. Full fat soya, due to its high oil content, has a short shelf life whereas soya bean cake processed by solvent extraction stays unspoiled for months. Solvent extracted soya bean cake has an average protein content of 44%, while the meal produced by the expeller method has an average protein content of 40%, and full fat soya, 37%.

26. The present production of solvent extracted soya bean cake is only one half of the total soya bean processed in Zambia and it only forms one third of the national requirement for soya bean cake (table 2). There is only one company (Premium Oil Industries, located in Lusaka) with a solvent extraction facility in the whole country. Its processing capacity for soya beans is about 60,000 tons per annum, a capacity adequate to meet the national requirement for this product, but not enough soya bean is grown in the country to meet the plant capacity. For instance, in the 1989/90 season, the plant could achieve only one fourth of its capacity. This situation therefore makes it very difficult for the animal feed industry to consistently produce high quality stock feeds.

Sunflower

27. The minimum protein level in sunflower cake stipulated by the Zambia Bureau of Standards for the lowest grade sunflower cake is 25%. However, the sunflower cake produced by the oil processing companies at best is about 26%. According to the sunflower seed processors the reason for this is that the seeds they procure from the farmers are of composite nature (of different sizes). This makes dehulling extremely difficult and results in substantial amounts of seed getting wasted along with the hulls. Because of this, the processors are reluctant to dehull the seeds and as a result the feed industry gets a very low protein quality and very high fibre (up to 40%) sunflower cake. This limits the inclusion rate of sunflower in feeds for monogastrics, especially poultry.

Cottonseed cake

28. The major constraint on the usage of cottonseed cake is its inherent gossypol content and high fibre level. It is not usually used at an inclusion higher than 3-5% in poultry and pig feeds. Considering that over 90% of stock feed produced commercially in Zambia are for poultry and pigs, the usage of cottonseed cake is highly limited.

Mineral sources

29. Sources of minerals for stock feeds are mainly salt, limestone flour for calcium, and dicalcium or monocalcium phosphate for calcium and phosphorus. Limestone flour is readily available in Zambia while salt and dicalcium or monocalcium phosphate are imported. Also imported are drugs, trace elements, vitamins and amino acid supplements.

IV. GENERAL DESCRIPTION OF THE EXISTING TECHNOLOGIES FOR ANIMAL FEED PRODUCTION

30. Stock feed producing plants that exist in Zambia today can be divided into two categories:

(a) Sophisticated or elaborate plants

These are the industrial feedmills and are mainly intended for grinding, dosing, mixing and pelleting compound feeds from cereals and oil meals, but not from roughage. The feed industry in Zambia is thus much more involved in the feeding of pigs and poultry than of ruminants.

The advantage of elaborate mills is that production is highly automated and mixing is quite precise. One company, National Milling Company, installed a computer in 1991 to improve the mixing of ingredients, particularly micronutrients, and for the production of concentrates to which farmers can add their own major ingredients such as energy sources and roughage.

(b) Simpler mill mix mills

These will consist of:

(i) Hammer mill
(ii) Platform scale
(iii) Mixer

The main equipment is the hammer mill and mixer. These are quite suited for farm mix and will easily cater for both ruminants and monogastrics.

31. It is clear that the stock feed industry in Zambia is geared essentially towards poultry and pig feed production except for a limited quantity of concentrates for cattle. However, taking into account the fact that the share of roughage in total feed resources represents about three quarters or more of the total, and that roughage constitutes 85% or more of feed intake in ruminants in developing countries (Agostini, 1985), there is a need for the feed industry to start producing complementary feeds for on-farm mixing with grain and roughage.

V. PRESENT CONSTRAINTS AFFECTING ANIMAL FEED PRODUCTION IN ZAMBIA

32. Food production per capita in sub-Saharan Africa has declined considerably during the last two decades which has resulted in a widespread food crisis and increasing dependence on food imports (FAO, 1986). Figures 1 and 2 show that production has fallen short of consumption in sub-Saharan Africa for two of the most valuable food-related livestock products, meat and milk. The productivity of livestock in this region in terms of meat and milk is said to be the lowest of any region world-wide (Gryseels, 1988). The increase in livestock output have been largely due to a numeric expansion of heads and flocks, rather than from increased yield per animal (Anteneh et al., 1988). This grim picture needs urgent attention if sub-Saharan Africa is to move away from the high import-base situation to self-sufficiency in food and be free from the almost endemic food crisis with which the sub-region has become associated. Solutions to constraints affecting animal feed production in Africa should be considered in the light of characteristics peculiar to the individual countries.

33. Zambia has a high urban population growth rate. For instance, between 1963 and 1969, the urban population was 29.4% of the total population. This rose to 35.3% by 1974 (National Commission for Development Planning, 1979) and 47% by 1983 (International Bank for Reconstruction and Development, IBRD, 1986). In the last census held in 1990 the urban population was estimated at about 55%. This rapid increase in urban population, the high annual population growth rate, the shortage of foreign exchange, and the fall in people's real incomes hence their purchasing power experienced since the mid-1980s following the devaluation of the Zambian currency, are all likely to lead to a decline in an already low animal protein consumption, worsening the existing protein deficiencies in the diets of the people, resulting in increased levels of malnutrition in the country.

34. Zambia's high urban population means that a relatively high proportion of the population is in that portion of income distribution where income gains are quickly translated into an incremental demand for livestock products. Coupled with the high population growth, it means an incremental demand of about 4% per year on meat and milk (Brumby, 1988). This high demand for livestock products calls for a very productive livestock sector. To achieve this, production should be based on a confined approach. The establishment of confined animal production systems to supply the urban centres with food-related livestock products will inevitably lead to increased demand for high quality animal feeds on a regular basis.

35. The consumer of stock feeds is the producer of livestock. In Zambia livestock producers can be broadly classified into two major sectors: the commercial sector, consisting of farmers engaged in farming activities on a large scale for the production of agricultural products for sale, and the traditional sector, consisting of small holders engaged in farming activities mainly for the provision of all or almost all the goods required by the farm household, usually without any significant surplus for sale. Table 3 shows estimates of livestock population in Zambia, dividing it into the traditional and commercial sectors. It is evident that livestock production in Zambia is dominated by traditional or subsistence farmers, owning on average 83%, 92% and 87% of the country's cattle, sheep and goats, and pigs, respectively. This means that if livestock output is to increase, animal productivity has to be improved in the traditional sector.

36. This is not an easy task as the small holders are usually located far away from urban centres, making it hard to reach them for the provision of inputs and services. Some problematic characteristics to increased animal productivity of the subsistence farmers are that they keep animals under low-input management systems, as an adjunct to crop production. Their main interest lies in the food crops on which the families depend for survival. They are usually resistant to change, new innovations and new ways of doing things. Another characteristic of these farmers is that they regard animals as assets rather than commodity. They would rather keep their animals and maintain, if not improve, their social status in their communities than sell their animals. Another characteristic is that the subsistence farmer has very low purchasing power. He would rather buy food or other essentials for himself and his family than buy feed for the livestock. The task therefore is how to penetrate the usually resource-poor small holder and convince him to use the feeds the stock feed industry produces to improve animal productivity.

37. Both technical and non-technical factors constrain livestock feed production in Zambia and these will be discussed.

(i) Technical factors

The feed industry is faced with a major problem in that despite the high demand for stock feeds, the industry cannot meet this demand mainly due to the fact that the machinery is old. The plants operate at about 50% capacity due to constant breakdowns. It is also difficult to get spare parts for machinery more than 25 years old. Expanding or overhauling the plants is not likely to be embarked upon as these parastatal companies are no longer making a profit. Such an undertaking is, in all probability, only possible through assistance from donor agencies negotiated through the government.

There is not enough storage capacity to store major ingredients such as energy and protein ingredients at plant sites. The supply, especially of protein resources, is often scarce and spasmodic. The supply of the major energy source, maize, is dependent on the surplus after the human requirement is met. These ingredients are from annual crops or by-products produced seasonally.

There is need for proper technology (e.g. for drying such products as brewers' grain) to be set up to allow for efficient use of wet agricultural or industrial by-products which could be valuable sources of proteins and/or energy in animal feeding. An example is brewers' grain from the thriving brewing industry in the vicinity of the plants, especially those in Lusaka the capital and Ndola on the Copperbelt.

There are no laboratory facilities at plant sites for testing and monitoring the quality of both raw ingredients used and feeds produced.

(ii) Availability of feed ingredients

The components of compound feeds, both imported and locally produced, are not always available at the right time. The limitations are due to:

- lack of currencies for importing ingredients. This has assumed greater importance in Zambia because of the depleted foreign exchange reserves and economic problems the country is facing;
- delays in unloading ships at harbours. This is an important factor in Zambia because of its landlocked geographic nature and the unfavourable political situation prevailing in such countries as Mozambique, Angola and South Africa whose sea ports she uses;
- insufficient quantities and/or poor quality of energy and protein ingredients produced locally.

(iii) Quality of feed produced

The quality of the feed produced is highly variable. The feed industry attributes this to variability in quality of locally-produced feeds. Inadequate supplies of ingredients and delays in shipments of ingredients at sea ports also lead to poor quality of feeds produced as feed producers adulterate feeds with lower quality feed material to keep the animal industry going while waiting for the arrival of good quality ingredients.

(iv) Localization

The feed manufacturing plants in Zambia are located on railway lines covering only four out of nine provinces. Feed plants, animals (pigs, poultry and dairy) and consumers of animal products are concentrated in or near city and town centres. Here, feed mills and intensive poultry, pig and dairy operations are able to meet a large consumer demand for animal products. On the other hand, beef and small ruminant production is dominated by small holders (see table 3) scattered over large areas away from urban centres. These are not catered for by the feed industry because of the distance involved in supplying feed, an undertaking that would increase the price of the feed; besides, the small holder is least able to afford feeds. The feed industry is geared to produce mainly feed for pigs and poultry, and is not adapted to producing feeds for ruminants that utilize abundantly available low quality roughage.

(v) Pricing policy and price increases of raw materials and stock feeds

Pricing policy used to be a problem especially between 1989 and 1991. The prices of raw materials were decontrolled while those of stock feeds remained under control. For instance, the price of maize was increased by 300% between July 1989 and July 1990. Prices of solvent extracted soya bean cake and full fat soya went up by 290% and 230% respectively, while that of sunflower cake increased by 126%. During the same period, prices of stock feeds were only allowed to go up by 140% on average. The feed manufacturers made big losses and resorted to adulterating feeds with poor quality feed materials in an effort to cut down on production costs. This affected the feed quality greatly.

In 1991 stock feed prices were liberalised, they were allowed to move in relation to the increase in costs of inputs for stock feeds production. However, the high feed prices led to reduced use of compound feeds and indeed lowered levels of animal production. The high feed prices mean that the animal products from species depending on compound feed are expensive and often beyond the reach of the majority of the people in the country.

(vi) Quality control

The Zambia Bureau of Standards has specified standards for various types of feeds, but these are difficult to implement. Feed formulators cannot carry out analysis for all raw materials, thus they tend to use data collected from Western Europe and North America which do not reflect the nutritive content of locally grown raw materials.

(vii) Institutional support

There is relatively a low level of government funding for research. There is need for support of local research into problems affecting the feed industry and the animal industry in general.

VI. RECOMMENDATIONS

38. Increases in livestock output are determined essentially by the quantity and quality of the feed available. The potential for local feed resources that can be used in compounding feed have been mentioned. It has been indicated that only minimal amounts of animal protein are available in Zambia. There is a need to increase the production of by-products of the meat processing

industry, in particular blood meal, meat and bone meal and poultry by-products meal, as these can form an important source of animal proteins. Most animals are slaughtered in make-shift slaughter shelters all over the country. To enhance blood meal, meat and bone meal, and poultry by-product meal production, efficient methods of collecting and processing these materials must be identified.

39. It has been pointed out that the production of oil cakes does not meet the requirement for stock feed production. What is needed are the necessary incentives for farmers to increase the production of oil seed crops. There is need to look at vegetable oil processing not only as a means to produce edible oil, but also to produce high quality cakes for stock feed production. This requires proper understanding of the industry and meaningful interaction and collaboration by the oil seed producers, oil seed processors and end users - stock feed manufacturers.

40. It has been mentioned that the quality of the sunflower cake produced is poor as processors do not dehull because of the composite nature of the seeds from farmers. In order to improve the situation, there is need for consorted efforts of seed producers, plant breeders, sunflower farmers and seed processors.

41. Following stock feed price decontrol, prices of stock feeds have risen sharply, mostly due to the increase in price of the major protein ingredients. These increases in prices of protein raw material sources are mainly due to the increase in the price of imported fertilizers used in the growing of these crops occasioned by devaluation of the Zambian currency. In light of this, there is need to look for alternative sources of protein as substitutes for the traditional protein sources. Research in this direction has been initiated at the University of Zambia. Seed cake from Ricinodendron rautanenii shinz, a tree growing in the wild, was included in the feed formulations for broilers, replacing soya bean completely. Broilers were raised on diets containing this cake and their performance compared well with that of birds raised on soya bean meal diets (Daura and Matauko, unpublished). The crude protein content of the cake (40%) and amino acid profile indicate that it compares well with soya bean cake. There is need for support for such research especially from the feed industry, as it stands to gain from such research.

42. For the improvement of the quantity and quality of stock feeds it is necessary to embark on plant rehabilitation of the stock feed plants. The quality control measures should be strengthened by modern laboratory and quality assurance systems at plant sites.

43. There is a need to open stock feed depots in areas of the country where stock feeds are not available at present. A cheaper way would be to produce concentrates that could be transported to these depots for reconstituting with energy feed ingredients rather than transporting compound feeds.

44. It is necessary for the feed industry to adapt to reality and to increase production of feeds for ruminants. This should include concentrate that would increase the efficiency of utilization of the abundant low quality roughage.

45. There are local feed resources that are grown in the country but not widely used in animal feed compounding. Sorghum, millet and cassava are some of the crops. Marketing agencies such as co-operative unions whose business it is to buy crops from farmers should buy these crops to encourage their production. They could be used to produce stock feeds which would reduce the

dependence on maize, reducing the competition between people and animals for maize grain, improving food security of the country.

46. By-products of the citrus industry are known to be good sources of energy for cattle, small ruminants and even monogastrics (Ammerman et al., 1963. Devendra, 1973). The citrus industry in Zambia produces quite substantial amounts of pulp which can be used for this purpose (Aregheore and Chimwano, 1992). Other by-products whose use in animal feed production should be explored include brewers' grains from the brewing industry and waste from opaque beer brewing.

47. To increase animal productivity in the traditional sector the strategy should, in the first place, be oriented to the immediate improvement of on-going farm operations and, in the long run, to the incorporation of these farms into the market system. Development plans must take into account the diversity of species of livestock on these farms. Appropriate packages for the different species must, therefore, be developed. These packages for small holder livestock producers should include feeding, health and hygiene and should be of a relatively small nature, because owing to the low income level of these farmers which would not justify large investments.

48. Since the main interest of small holders is to produce crops on which the families can depend for survival, integration of crop and livestock production should be encouraged. The wealthier farmers in small holder communities prove to be those with the greatest number of animals. The causal chain in this progression to greater wealth starts with modest management changes that increase the farm income from livestock sales, thereby enabling more fertilizer to be purchased to increase grain output. The incremental crop residues then sustain greater numbers of more productive livestock. It should be borne in mind that improvements in livestock output lead to an upward trend in the productivity and income of small farmers (Brumby, 1988). The stock feed producer can help by making concentrates that will improve the utilization of the abundant crop residues and natural forages.

VII. CONCLUSIONS

49. Zambia has the potential to be self-sufficient in supplying the main feed ingredients, and only needs to import specialized additives and medicants. This means that potentially over 90% of the feed cost is local component which is favourable for livestock development in the country. There is, however, a need to produce more animal protein sources and improve the production of high quality plant protein sources. Efforts should be directed towards finding cheaper substitutes for the more expensive protein sources. There is high potential in using locally-produced feed resources such as sorghum, millet and cassava in feed compounding which are currently not used by the feed industry. Increased use of these will release maize, the staple food, for human consumption, improving the food security of the country. Price increases of raw materials, stock feeds and animal products as well as the availability of raw materials are the major constraints in livestock feed production. Encouraging the small holder who dominates animal ownership in Zambia to improve his productivity will lead to an expanded market for stock feeds.

REFERENCES

Agostini, B. 1985. Patterns of feed utilization and trade. In: R. Sansoucy, T.R. Preston and R.A. Leng (Ed.). Proceedings of the FAO expert consultation on the substitution of imported concentrate feeds in animal production systems in developing countries. Bangkok.

Ammerman, C.B., Arrington, L.R., McCall, J.T., Wing, J.E. and Davis, G.K. 1963. Nutritive value of dried citrus pulp for steers. J. Anim. Sci. 20:398. (Abstract).

Anteneh, A., Sandford, S. and Anteneh, B. 1988. Policy, finance and technology in livestock development in sub-Saharan Africa: Some critical issues. ILCA Bulletin No. 31, p.2.

Aregheore, E.M. and Chimwano, A.M.P. 1992. Crop residues and agro-industrial byproducts in Zambia: availability, utilization and potential value in ruminant nutrition. In: J.E.S. Stares, A.N. Said and J.A. Kategile (Ed.) Complementarity of feed resources for animal production in Africa. Proceedings of the joint Feed Resources Networks Workshop. Gaborone, Botswana.

Brumby, P. 1988. Strengthening the Bank's Livestock Program Future Directions.

Chako, C.A. 1990. A review of stockfeed industry in Zambia. In: Stockfeeds industry in Zambia. Technical Bulletin Vol.1 (3):23.

Daura, M.T. and Matauko, K. The use of Ricinodendron rautanenii schinz as a protein source in broiler diets. (Unpublished).

Devendra, C. 1973. Effect of level of inclusion of citrus meal on the digestibility of concentrato diet for sheep in Trinidad. Tropical Agriculture (Trinidad).

FAO. 1986. African agriculture: the next 25 years. Annex III: Raising productivity.

FAO. 1991. Livestock production and health for sustainable agriculture and rural development. FAO/Netherlands Conference on Agriculture and the Environment. S. Hertogenbosch, The Netherlands.

Gryseels, G. 1988. Role of livestock on mixed smallholder farms in the Ethiopian Highlands: a case study from the Baso and Worena Wereda near Debre Berhan. Agricultural University, Wageningen, (Dissertation).

ILCA (International Livestock Centre for Africa). 1990. Annual Report.

ILCA. 1991. Annual Report.

International Bank for Reconstruction and Development, Washington D.C. 1986. Population growth and policies in Sub-Saharan Africa.

Lee, P.J.W. 1991. A review of poultry feed for Zambia.

Liteta, D.L. and Ngulube, E. 1991. Commercial poultry production study - Zambia.

Musenge, R.H.L. 1990. Stockfeeds - Process, Production and Usage. In: Stockfeeds Industry in Zambia. Technical Bulletin. Vol.1 (3):1.

National Commission for Development Planning. 1979. Zambia Third National Development Plan 1979-83, p.75.

Schlesinger, L. and Stekel, A. 1973. Rev. Child Ped. 44:455.

Scott, M.L., Nesheim, M.C. and Young, R.J. In: Nutrition of the chicken. 2nd edition, Chapters 23 & 28. M.L. Scott and Associates, Ithaca New York.

Table 1 National stockfeed production, 1980-1991 ('000 MT)

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990 *	1991 *
Output	192	179	147	145	136	144	146	140	130	160	140	140

Sources: DANIDA Feasibility study on rehabilitation of maize and feed mills in Zambia, 1989.

* Lee (1991). Booker Tate Ltd.

Table 2 National Oil Cake requirement and production for 1989/90 period.

Oil cake	Requirement (MT/year)	Quantity Produced (MT)	Excess/(Deficit) (MT)
1. Soyabean cake			
a) solvent extracted	36,8000	12,400	
b) mechanical extraction		900	
c) full fat soya (extrusion)		10,000	
Subtotal		23,300	
Deficit			(13,500)
2. Sunflower cake			
a) solvent extracted	9,600	3,200	
b) mechanical extraction		5,000	
Subtotal		8,200	
Deficit			(1,400)
3. Cottonseed cake*			
a) mechanical extraction	4,800	7,000	
Excess			2,200
Total	51,200	38,500	
Deficit			(12,700)

Source: Chacko, 1990. A review of stockfeed industry in Zambia.

* Cottonseed cake is used extensively by cattle farmers for mixing in the feeds for their animals, and quantities thus bought by cattle farmers are not included in the national requirement for cottonseed cake.

Table 3. Estimates of Livestock population in Zambia ('000 held)

Year		Cattle			Sheep & Goats			Pigs		
		Commercial	Traditional	Total	Commercial	Traditional	Total	Commerical	Traditional	Total
1985		393	2077	2470	32	424	456	22	156	178
	% of total	15.9	84.1		7.0	93.0		12.4	87.6	
1986		413	2107	2520	35	454	489	24	163	187
	% of total	16.4	83.6		7.2	92.8		12.8	87.2	
1987		433	2167	2600	40	485	525	26	170	196
	% of total	16.7	83.3		7.6	92.4		13.3	86.7	
1988		455	2229	2684	43	520	563	28	179	207
	% of total	17.0	83.0		7.6	92.4		13.5	86.5	

Source: Zambia, Ministry of Agriculture and Co-operatives, Planning Division, Statistics Section, 1988.

Table 4. Crops Produced and Marketed 1988 (MT)

	Produced	Marketed	Retained
Maize	1.9	1.3 Million	.6 million
Sorghum	23,000	3,000	20,000
Millet	27,000	500	26,500
Soybean	21,600	19,700	1,900
Sunflower	18,400	17,200	1,200
Seed Cotton	58,500	58,500	0
Ground nut	33,400	32,800	600

Source: Zambia, Ministry of Agriculture and Co-operatives, Planning Division, Statistics Section, 1988.

Figure 1. Per caput production and consumption of all meat, 1972-85

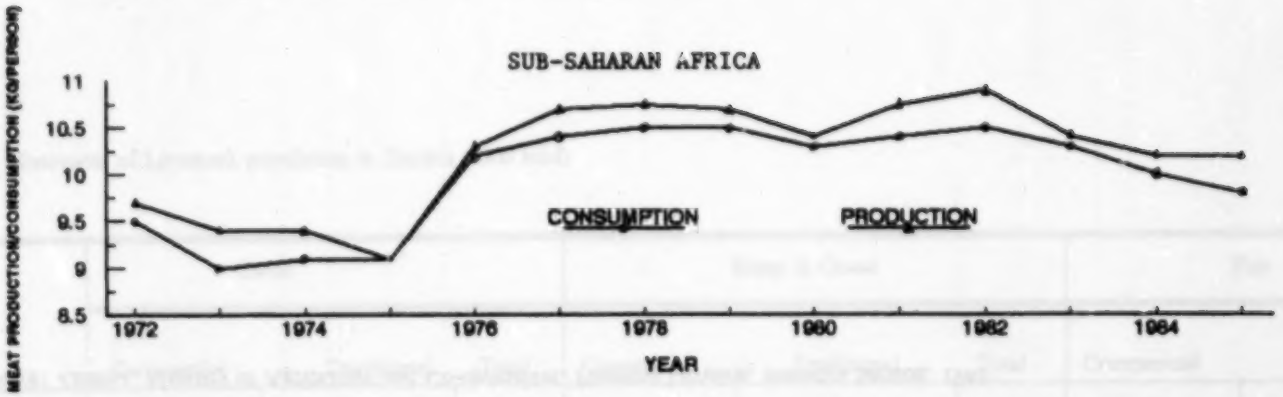
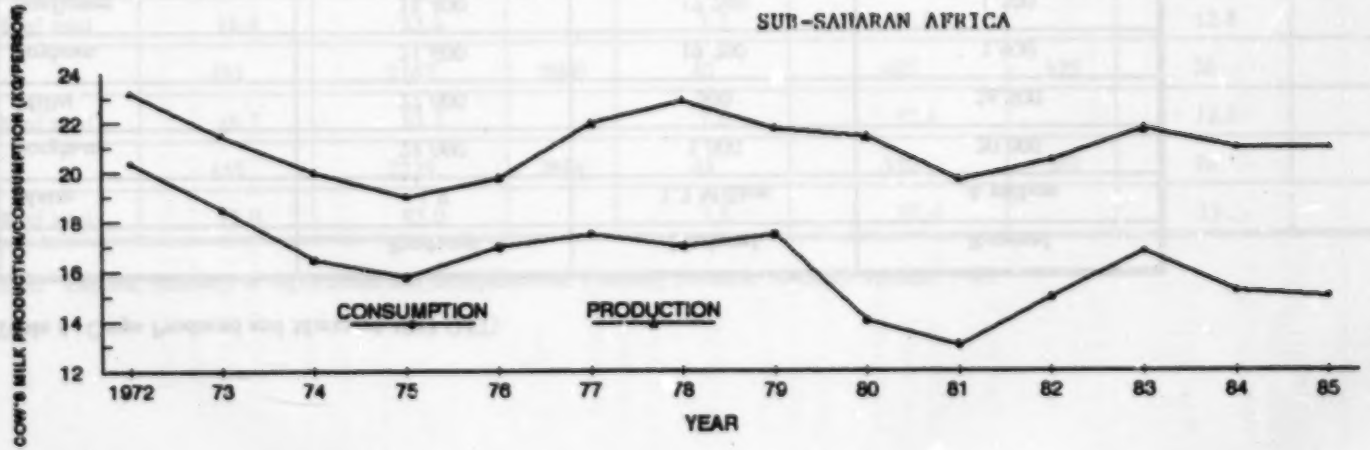


Figure 2. Per caput production and consumption of cow's milk, 1972-85



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PRESENT SITUATION AND DEVELOPMENT ASPECTS OF THE ANIMAL FEED INDUSTRY IN GHANA

Information paper*

Prepared by

Oladipo Onayemi
UNIDO Consultant

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* The views expressed in this document are those of the author and do not necessarily reflect the views of the Secretariat of UNIDO. Mention of firm names and commercial products does not imply the endorsement of the United Nations Industrial Development Organization (UNIDO). This document has not been edited.

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SUMMARY

The development of the animal feed industry in Ghana is described in the context of land use pattern, current agricultural practices, available feed resources, and utilisation of crop residues. For ruminants which depend on forage, shrubs and trees, the use of agro-industrial by-products during the dry season will ensure that weight loss is minimised and the productive performance is improved.

Agricultural technology should be improved in order to increase the output of cereal and other crops and reduce the scarcity and high cost of these commodities for feed which particularly threaten the pig and poultry enterprise. Further research is necessary in order to define the limits of inclusion, toxicity, and performance of animals on feed containing agro-industrial by-products.

To encourage the use of agro-industrial by-products in practical feeds, there is a need to strengthen the extension services between the feed producers and the farmers. Credit incentives should be given by the Government to feed producers who use a stipulated minimum amount of agro-industrial by-products in their feeds.

Government policies on agricultural inputs, credit facilities, and guaranteed prices need to be reviewed to encourage investment in agriculture and especially in feed production as an enterprise. In order to promote co-operation in industrial development among countries within the region, countries which have comparative advantage in some food/feed ingredients should be encouraged to sell such products to one another.

I. STRUCTURE OF THE ANIMAL FEED PRODUCTION INDUSTRY IN GHANA

1. The livestock feed industry in Ghana falls into two categories depending on the type of animal:

(a) Ruminant species which depend on natural grasslands abundant during the rainy season, and require feed supplement during the dry season;

(b) Monogastric animals (poultry and pigs) which depend on crop and other products.

2. In either case, the feed industry relies on small livestock owners who keep a few herds of cattle or goats and sheep on their farms, while the poultry farmers rely on commercial feeds prepared by the farmers or companies from maize or fish meal either for use on their farms or at small industrial locations where they are used for their animals or sold to the livestock farmers in their locality and beyond. Tables 1 and 2 show the livestock population in Ghana during the period 1987-1990.

3. Despite the modest increase in the livestock population in Ghana, there has only been a 10 per cent increase in the meat supply from domestic sources. Tables 3 and 4 show that both cattle and poultry (each contributing one-third of the total meat supply) contribute the bulk of the animal protein supply. The supply of protein from cattle or poultry sources is generally expensive and is mainly attributed to the problem of feed availability, water supply, availability of improved breeding stock, disease control, and high lending policies to the livestock sub-sector.

4. Feed takes between 60-85% of the cost of producing poultry and pigs. Factors which will promote the use of agricultural industrial by-products in feed formulation in order to develop the livestock industry are the focus of the paper.

Ruminants - cattle, goats, sheep

5. It is generally believed that ruminants only require pasture for sustenance and development, and an unlimited supply of natural grassland exists in the free range including herbs and shrubs. The major problem is to provide these animals with food and water during the dry season, when weight loss (up to 30% live weight) and poor reproductive performance occur. Table 5 shows the land-use pattern in Ghana. It can be seen that permanent pasture land has been decreasing at the expense of farming and other uses which suggests that feed resource use can be increased only through crop production. Local pasture (grass) is low in total digestible crude protein and high in fibre. It is over grazed because of over stocking and communal ownership of the grassland.

6. The grazing animal does not harvest more than 50% of the potentially herbaceous biomass nor do forage resources from trees and shrubs form more than 20% of the normal feed of the grazing animals. Large herd owners allow the pasture to be overgrazed and soil degradation occurs. In the humid forest and derived savanna zone where grazing is available all the year round, the threat of trypanosomiasis has limited cattle production and enhanced small ruminant production. Numbers of large animals are restricted because they can destroy arable crops; they are thus fed with household scrap.

7. During the rainy season, the dry matter content of the forage is almost 80% and this decreases to 20% during the dry season. It is during the dry season that many cattle farmers resort to the use of crop residues.

8. Crop production statistics of Ghana are shown in Table 6. Crop residues from these values have been estimated on factors obtained by considering the yield of potential food available from these crops during processing. Table 7 shows the potential feed resource production from grassland and crop residues. The table indicates that for Ghana, crop-residues could give about 61% of the dry matter, 65% of the total digestible nutrient and 70% of the digestible crude protein to animal feed requirements.

9. Crop residues, however, are of different types and characteristics and are obtained from crop processing operations. Quantitatively, they consist of the small households to industrial agricultural by-products from operators. In general, they are of low value in monetary terms and in nutrient content and often represent waste to the layman. In some cases, they are often high in moisture, and usually require further processing in order to utilise them in feed formulation. They are, however, high in nutrient and easily digestible.

10. Much success has been recorded in supplementing livestock feed with agricultural by-products in order to maintain the live weight of the animal and productive performance. They include cocoa pod husk, banana and plantain leaves, cassava peels, rice straw, cereal offal, sugar-cane molasses, pineapple peels, etc.

11. In many parts of Ghana, rice straw treated with urea is widely used as a supplement for ruminants during the dry season. Other cereal by-product residues need further treatment or reduction in size before being fed to ruminants or incorporated as a supplement. It has been shown that modifying cereal straw by treating it with caustic soda or urea could serve as supplementary feed to ruminants. The problem is that the technology for modification or treatment has not been widely transferred or adopted by the livestock farmers.

12. Livestock is increasing at an average rate of 4.18 per cent which means that natural grazing cannot continue since all land suitable for cultivation will be required to produce human food. It is now known that pasture lands have been decreasing at the expense of farming and other uses, an indication that it might be possible to increase feed resources through increased crop production in the short-term, the residue of which will be used as feed supplement. The current agricultural production technology suggests that crop output cannot keep pace with population growth let alone leave a surplus for livestock feed. What has been recommended is that improved pasture consisting of legumes and grass be established and managed for higher carrying capacity while crop residues could be used as supplementary feed during the dry season.

Monogastric animals: poultry and pigs

13. Although Ghana has always been a crop-production nation, with fishing and hunting as associated business, a large number of people are engaged in the commercial poultry and piggery business; more than 50% of the animal protein demand of the population is derived from locally-raised poultry. Many Ghanaians do not receive the minimum daily recommended levels of protein because high feed costs have led to an irregular supply of almost all animal protein products. Feed takes between 60-85% of the variable cost of producing poultry and pigs in Ghana. The main reason is the inadequate production or scarcity of the major basic feed ingredients, notably maize and fish meal. The

competition for these ingredients by man is also responsible for their scarcity for use in livestock feed.

14. The main feed ingredients are not locally available in reasonable quantity and have to be imported. Maize, for instance, has to be imported almost every year since local production cannot keep up with the demand. Much effort and research have been directed at replacing the main feed ingredients in order to reduce the cost of feed using a number of crops or their by-products. Some degree of success has been reported but there is a limit to how the substitution could be made without affecting the quality and performance of the animal, either for meat or egg production. The use of alternative and cheaper resources of protein and energy in feeding farm animals has become a vital point of interest for the growth of the local livestock industry. Table 8 shows the production of selected food crops.

15. While the protein source in poultry feed can be replaced by vegetable protein, there is no cheap substitute for maize. Cassava is very expensive to produce under the present farming conditions in Ghana although it is a feed ingredient in other parts of the world. There is a possibility that in future cassava might be used in livestock feed if new improved varieties are planted and the necessary inputs supplied so that the maximum yield can be obtained and considered as feed crop in its own right.

16. By their nature, agro-industrial by-products when properly processed and incorporated as replacement or supplement in conventional feed formula, are more digestible and will reduce costs thereby stimulating development in the livestock sector.

17. However, extension services need to be strengthened, and research should be undertaken to solve the problem relating to:

- further processing and cost of using agro-industrial products;
- storage characteristics, e.g. rancidity in high fat ingredients, eg. groundnut cake, soy bean cake.

II. ECONOMIC FACTORS WHICH INFLUENCE THE ANIMAL FEED PRODUCTION AND UTILIZATION SECTOR

18. Because of the need to maintain the performance of imported and local cattle particularly during the dry season, and with the advent of modern intensive rearing of poultry and pigs to meet the demand of the population for eggs and meat, livestock feed production on a commercial scale has become an important economic activity of livestock production. Birds which were imported needed constant and good-quality feed, and profit consideration by feed millers aside, the commercial feed production was part of the package to improve meat supply by importation of birds. Another interest was the need to utilise the by-products from flour milling operations and breweries. About 30 years ago, the Ghana Food Distribution Complex at Tema had a programme to utilize the wheat offals.

19. There are a few reports on the use of agro-industrial by-products in practical livestock feeds in Ghana, partly due to lack of appreciation of their nutritional importance and the reluctance of the farmers to use them. The small quantities of agricultural by-products that are available are scattered over a wide area and it requires investment in transportation, technology and

further processing to incorporate them into practical feed. There is also a need to market the feed containing the by-products. But perhaps more important is the increasing scarcity of conventional feed resources, as well as uncertainty of production and high prices. At present, certain economic considerations underlie the development of the feed production industry in Ghana. These are:

i. The need to contribute to the agricultural sector through animal husbandry.

ii. The need to supply feed to imported poultry for which there has been a considerable investment.

iii. The need to reduce the cost of feed in order to optimise the use of major feed ingredients required for local foods. The need to contribute to development activities and supply of feed to animals and maximise the use of crop resources are some of the factors which influence animal feed production. The low cost of feed will be translated into lower cost of animal protein and promote better health.

iv. The need to utilise the by-products which could have been disposed of as waste without any monetary value. As stated earlier, agro-industrial by-products such as groundnut cake, SBM, PKM, when properly treated, and incorporated at a level which does not adversely affect the efficiency or performance of the animal, could contribute to the animal product (meat, eggs, milk).

v. The necessity, in some cases, to further process the agro-industrial by-product prior to its use. The cost recovered will not only benefit the animal feed producer but will reduce the cost of disposing of the by-products.

20. It will be realized that farmers at the home level have raised pigs and poultry on by-products of food processing operations. The animals thus contribute to the value of the crop and when they are sold, they provide some income to their owners.

III. ACTION TO BE TAKEN TO UTILIZE AGRO-INDUSTRIAL BY-PRODUCTS AND RESIDUES FOR PRODUCTION OF ANIMAL FEED

21. In order to utilise agro-industrial by-products for the production of animal feed, two lines of approach are suggested:

(a) To incorporate the by-product into a conventional maize-based diet as replacement;

(b) To develop a new feeding system based entirely on the use of agro-industrial by-products.

22. It must be realized that the first proposition is easy to achieve and is highly recommended. To adopt this method for practical feeding, there is need to screen the locally-available feedstuff for its chemical composition, level of incorporation, toxicity and effect on production performance on the stock.

23. The main organizational problems limiting the use of agro-industrial by-products are related to:

(a) lack of transport facilities to collect the by-products from the small-holder crop-processors to a central location where they could be reprocessed by drying to reduce the bulk and size to incorporate them into regular feed or modify the by-product where necessary;

(b) lack of an organized marketing system whereby the by-products are traded like the main crop - e.g. the cocoa pod husk is seen as a waste with no real value. If the company is interested in re-processing and selling it to feed millers there will be a greater revenue to the cocoa farmers generated by the sale of the cocoa pod husk in addition to the revenue from the cocoa beans.

IV. FINANCIAL ACTION

24. Agro-industrial by-products are generally bulky and low in nutritive value and are usually considered as industrial pollutants by food processors. For example, because of lack of demand for the sugar bagasse produced by a distillery company, this product is burnt by the factory. It is possible to devise a system of reward to industrial processors who are able to market the by-products after investing in re-processing plants in order to ensure that such by-products are utilised in feed production. Here, additional investment is required.

25. The revenue derived from the sale of the agro-industrial by-product represents an insignificant source of income to the crop producer or processors, but the amount could be used to offset the cost of disposing the waste.

26. In order to promote the use of agro-industrial by-products, the government could introduce a credit scheme to industrial feed millers who use a certain minimum percentage of the locally-produced by-products in their formulas. With this method, there would be a deliberate effort to consider the by-product as a feed resource and thus reduce the pressure on the main food crop.

V. EXISTING AGRICULTURAL RAW MATERIALS IN GHANA WHICH ARE POTENTIAL SOURCES FOR THE PRODUCTION OF ANIMAL FEED

27. Almost all conventional agricultural raw materials, i.e. cereal, cassava or the by-products of wheat brans, rice husk, cassava peel, plantain peel, brewers spent grain, sugar molasses, can be used for the production of animal feed.

28. The main limitation for the use of the main crop is the competition for use of the same crop as food and the prohibitive cost of production under the present agricultural technology and practice. It costs three times more to produce the same quantity of cassava than maize and the economics of production are not in favour of using conventional food crops for livestock feed or for their by-products.

29. The quantities of crop products such as maize and cassava are hardly sufficient to satisfy human needs under the present farming system let alone

to use them in production of feed. It is only in the foreseeable future when agricultural technology and farming systems have improved that conventional feed will be used in feed production.

30. The crop residues (or agro-industrial by-products) on the other hand, will be relied upon as an important feed resource in Ghana in the not too distant future. What is required is determination of the value and level of incorporation after they have been treated.

31. It has been demonstrated that fish meal, which is a protein source in typical poultry feed, could be replaced by vegetable protein. A list of the potentially-available proteins available in Ghana (Table 9) indicates that research is needed to determine the acceptable level of substitution of the vegetable protein, toxicity factors and their storage characteristics and the processing techniques to be adopted in optimising their use in the production of animal feed.

VI. ROLE OF SMALL- AND MEDIUM-SCALE ENTERPRISES IN THE ANIMAL FEED PRODUCTION SECTOR

32. The distinction between small- and medium-scale enterprises is based on the scale of feed production, capital investment, number of employees and organizational set-up in terms of marketing outlets or network and quality assurance. The animal feed production sector is dominated by small-scale operators characterised by small livestock owners who have either a few herds of a maximum of 100 head of cattle and/or goats and sheep or poultry and pigs. In the Upper East, West and derived Savanna Zone in the southern parts of Ghana, cattle, sheep or goats are kept for cash income, prestige and payment of dowry and are allowed to graze on the local pasture shrubs or browse and feed on kitchen wastes or scraps from crop residues during the off-season. It is only in recent times that the cattle have been fed on urea-treated rice straw as a supplement in order to maintain their body weight during the dry season.

33. The small-scale poultry and pig enterprises occasionally prepare their own feed when they can afford the investment in milling machines and ingredients to prepare the feed for their livestock production of up to 1000 metric tons/year. Because of the technical difficulties which the small operators encounter when the machines break down or the feed ingredient becomes prohibitively expensive, small enterprises resort to buying their feed from medium enterprise feed operators.

34. Medium-scale animal feed enterprises comprise two types:

(a) Those which are owned either by Ghana nationals in partnership with foreign partners, or those which are owned exclusively by Ghana nationals. In most cases, poultry or pigs are kept and enough feed produced to meet their needs with the surplus being sold to a few clients who purchase their drugs or birds from the hatchery.

(b) The other class of medium-scale feed producers were able to sustain a 15.6% growth (in 1991) to keep pace with growth of poultry in spite of the enormous constraints under which they operate. Government assistance is necessary in order to enable these enterprises to contribute to the industrial development of Ghana in the food production sector.

VII. LOCAL MANUFACTURE OF ANIMAL FEED PRODUCTION EQUIPMENT AND IMPORT REQUIREMENTS

35. The small- and medium-scale animal feed production sector relies on small-scale equipment which is simple to operate. Local plate mill, which is powered by simple electrical motors is quite common, especially among the small-scale feed producers. The medium-scale feed producers have able technicians to carry out routine maintenance of their equipment and machinery and assure continuous production when the feed ingredients are available.

36. There is also a large pool of artisan and small foundries in the township where the enterprises are located where replacement parts can be improvised. Very few machine items are imported from the original suppliers of the equipment, thus ensuring that there is continuous production.

VIII. PRESENT CONSTRAINTS AFFECTING THE ANIMAL FEED INDUSTRY IN GHANA

37. As stated earlier, the animal feed industry in Ghana is not expanding to meet the demand either on a short-term or long-term projection of livestock production and entrepreneurship development. The growth of the feed industry is constrained by the following:

i. Crop production, especially food crops, is not growing at a rate that would leave enough surplus for the livestock feed sector due to inadequate use of inputs and adoption of inappropriate farming technology. The Government should provide the necessary incentives to encourage increased activity in the farming sector. These incentives could include credit to farmers, provision of insurance schemes and providing inputs - fertilizer, land-clearing incentives using tractors, etc. Because of the low output of the main ingredients, feed producers resort to importation and low capacity utilization of their equipment and capital outlay. The current rate of borrowing money for agricultural ventures (23-24%) is a disincentive to prospective investment because of the risky nature of agricultural enterprises.

ii. Commercial grazing areas with improved pasture consisting of grass/legume mixture should be established in those areas where cattle is currently grazing uncontrolled.

iii. Extension services which will bring the problems of the farmer to the researcher should be strengthened and equipped with qualified staff. These services should also offer training and educate feed producers in the value of agro-industrial by-products and the level to substitute in their formula.

iv. Most animal feed producers stated that the Government's monetary policy, especially on credit, is a disincentive to borrowing for expansion and even operation. It is recommended that this aspect be reviewed so that feed producers could buy and store maize and fish meal, thereby helping the farmers of these commodities.

v. A Government liberalization policy has encouraged the import of food and feed ingredients, thus rendering local production uncompetitive with the cheap imported ones. The poultry industry and the beef market have thus suffered and those who invested in these sectors are finding it difficult to survive. It is suggested that Government policies should be consistent in order to protect local investors who are contributing to development.

vi. There is concern that besides the high price, the quality of locally-produced fish meal is poor, often containing a higher level of sand than is desired. It is suggested that the feed millers should educate the fishermen on the technology of catching and drying fish so that they can produce according to specifications.

vii. Research is needed to determine which of the feed ingredients could be replaced by local ingredients or agro-industrial by-products. Support should be provided by researchers to carry out investigations rather than relying on importation of those ingredients which could be sourced locally. Infrastructural facilities should also be set up by the feed producers to test the quality of the product formulated with local ingredients or those purchased on the open market. This will enable both the producer and user of the feed to establish mutual confidence.

IX. ANIMAL FEED MARKET IN GHANA

38. It was suggested that commercial ranching with improved pasture be set up so that cattle stocking rate, grazing intensity and soil degradation could be controlled. For feeding during the dry season, greater emphasis should be placed on agro-industrial by-products under the feedlot system. Since free grazing areas are becoming limited, it is proposed that industrial grazing, together with greater use of well-treated crop residues will minimise the effect of nutritional problems on livestock production in Ghana.

39. There is a need to develop a feed production sector as an industrial activity if the agricultural system that ensures improved crop output is to be effective. Incentives should be given to enable medium feed producers to operate at higher capacity than is currently the case. Small feed operators should be given franchise to produce under specified conditions so that the quality of the poultry feed is guaranteed. There are well-known brand names on the market with their organizational set-up, and facilities for investment. A better scale of operation is thus envisaged.

X. PROPOSALS AND MEASURES TO STRENGTHEN REGIONAL CO-OPERATION AT ALL LEVELS

40. The following proposals and measures to strengthen regional co-operation are suggested:

i. The high cost of feed ingredients is one of the main constraints of livestock enterprise in Ghana. Because of the low production of maize and the seasonal nature of fish meal, etc., the producers had to import ingredients from South America and the USA. There are some countries in West Africa which can supply these ingredients at reasonably low prices comparable to those paid for imports from South America or the USA.

Fish meal could be imported from Senegal and yellow maize from South Africa. Improved high yielding varieties of cassava have been released by the International Institute of Tropical Agriculture, Ibadan. It is now possible to obtain a yield of 29 tons/ha rather than 7.9 tons/ha which is the current production figure. By planting the new cassava varieties with the correct inputs, it is possible to increase the yield of cassava and have enough for the feed sector. It is possible to import dried cassava chip from

neighbouring West African countries for this purpose should it not be possible to open up new land for cultivating cassava.

ii. As a way of promoting interregional co-operation, it might be profitable to sell cattle from one country to be fattened in another where industrial cattle ranches are established. The economic factors clearly outweigh the sentimental or cultural issues.

iii. The technology of agro-industrial by-product utilization should be evaluated, promoted and disseminated to industrial enterprises in the region.

iv. Regional laboratories for analyzing the quality of commercial feed should be set up by either the Government or feed producers, and animal nutritionists should be encouraged to move across borders to exchange knowledge and ideas about feed formulation, etc.

v. Governments in the region should review their policies on enterprise development and provide a conducive environment to encourage investment in the feed sector through tariffs, tax incentives and legal instruments.

vi. Where one or more feed producers have a comparative advantage on the economics of feed production, appropriate incentives should be provided to enable the company to open up in another country or operate under a franchise in that country. This will promote and facilitate trade, industrial development and ensure regional co-operation.

Table 1: Livestock population in Ghana
('000)

Type of livestock	1987	1988	1989	1990
Poultry	8,214	8,040	8,738	9,686
Sheep	1,989	2,046	2,212	2,555
Goats	1,901	1,991	2,363	2,834
Cattle	1,170	1,145	1,136	1,158
Pigs	398	478	559	677

Source: Agriculture in Ghana: Facts and Figures issued by Ministry of Agriculture, Accra, November, 1991.

Table 2: Index of livestock population
(1984 - 1986 = 100)

Type of livestock	1987	1988	1989	1990
Poultry	110	108	117	130
Sheep	103	106	115	133
Goats	116	121	116	173
Cattle	109	107	106	108
Pigs	93	111	130	157

Source: Agriculture in Ghana: Facts and Figures issued by Ministry of Agriculture, Accra, November, 1991.

Table 3: Meat production

Type of Livestock	Estimated 1985	Meat 1987	Production 1989	(Tonnes) 1990
Cattle	14,254	15,661	18,000	19,800
Sheep	8,943	8,948	8,500	8,580
Pigs	8,262	7,979	5,040	5,544
Poultry	8,020	6,571	3,200	3,520
Goats	6,020	7,128	8,580	8,580
Total	45,499	46,287	43,400	46,024

Table 4: Index of meat production
(1985 = 100)

Type of Livestock	1987	1988	1989	1990
Cattle	109	107	106	108
Sheep	103	106	115	133
Pigs	93	111	130	157
Poultry	110	108	117	130
Goats	116	121	116	173

Table 5: Land use pattern in Ghana

Land use characteristics	10^3ha		% Change
	1971	1986	
Total area	23854	23854	-
Land area	23002	23002	-
Water bodies	852	852	-
Permanent cropland	1600	1720	7.5
Arable lands	1000	1140	14.00
Forest and woodlands	9400	8350	-11.11
Permanent pastures	3560	3410	- 4.21
Other lands	7442	8382	12.63

Source: F.A.O. (1988) Food and Agriculture Organization Production Yearbook.

Table 6: Feed resource production from the natural grassland and crop residues

Nutrient Characteristics	Sources	1970	1975	1980	1985	% Contribution in the average total
Dry matter 10^6mt	Grass	7.50	7.40	7.30	7.20	43.39
	Browse/ Shrubs	3.19	3.15	3.10	3.06	17.67
	Crop Residues	7.01	6.06	6.66	6.77	39.03
	Total	17.70	16.11	17.06	17.03	100.00

Nutrient Characteristics	Sources	1970	1975	1980	1985	% Contribution in the average total
Total digestible nutrients 10^6mt	Grass	3.80	3.75	3.70	3.65	39.12
	Browse/ Shrubs	1.97	1.95	1.91	1.89	20.16
	Crop Residues	4.06	3.54	3.92	3.95	40.62
	Total	9.83	9.24	9.53	9.49	100.00

Nutrient Characteristics	Sources	1970	1975	1980	1985	% Contribution in the average total
Digestible crude protein 10^3mt	Grass	128.25	126.54	124.83	123.12	19.27
	Browse/ Shrubs	261.58	258.30	254.20	250.92	38.05
	Crop Residues	270.46	261.82	307.30	273.80	42.68
	Total	644.50	635.86	681.34	647.84	100.00

Source: J.E. Fleischer (1992) Dept. of Animal Science, University of Ghana, Legon.

Table 7: Amount of feed resources from natural grassland and crop residues that are potentially consumable

Nutrient Characteristics	Sources	1970	1975	1980	1985	% Contribution in the average total
Dry matter 10^6mt	Grass	3.75	3.70	3.65	3.60	33.64
	Browse/ Shrubs	0.64	0.63	0.62	0.61	5.76
	Crop Residues	7.01	6.06	6.66	6.77	60.60
	Total	11.40	10.39	10.93	10.98	100.00

Nutrient Characteristics	Sources	1970	1975	1980	1985	% Contribution in the average total
Total digestible nutrients 10^6mt	Grass	1.90	1.87	1.85	1.82	30.39
	Browse/ Shrubs	0.40	0.39	0.38	0.38	6.37
	Crop Residues	4.06	3.54	3.92	3.95	63.24
	Total	6.36	5.80	6.15	6.15	100.00

Nutrient Characteristics	Sources	1970	1975	1980	1985	% Contribution in the average total
Digestible crude protein 10^3mt	Grass	64.13	63.27	62.42	61.56	16.01
	Browse/ Shrubs	52.33	51.66	50.84	50.18	13.06
	Crop Residues	270.46	261.82	307.30	273.80	70.93
	Total	386.91	376.75	420.56	385.54	100.00

Source: J.E. Fleischer (1992) Dept. of Animal Science, University of Ghana, Legon.

Table 8: Production of selected food crops
('000 MT)

Crop	1987	1988	1989	1990
Cassava	2728	2300	3320	2717
Yam	1185	1200	1280	877
Plantain	1078	1200	1040	799
Cocoyam	1012	1115	1200	815
Maize	598	600	715	553
Sorghum	206	178	215	136
Groundnut	191	230	200	113
Millet	173	192	0.80	75
Rice/Paddy	81	105	67	81
Pineapple	8	9	10	10

Source: Ministry of Agriculture. The quantity of by-products generated can be calculated using the fact that root crops in general yield 40% waste. Rice paddy yields 50% waste and for sorghum, maize and millet the by-product is generated in the order of 30 per cent.

Table 9: Some potentially-available protein sources in Ghana

Protein sources	Why used	Upper limit of inclusion (%)	Reason
Soy bean meal	Protein; energy	20 - 30	Soy in fat
Groundnut cake	Protein; energy	20	Fat Rancidity
Copra cake	Protein	10	Poor palatability
Palm kernel cake	Protein		Low palatability
Cotton cake	Protein	5	Colouring effect
Rice bran	Dilution		
	Protein	10	Fibre, Fat
Maize bran	Energy	10 - 15	Fibre, Moisture
Wheat bran	Protein	25	Fibre
spent grain	Energy, protein	15	Fibre
Pito mash	Protein	10	Fibre, tannin
Oil palm slurry	Energy	10	Rancidity
Cocoa pod husk	Dilution, cost	10	Fibre
Cassava peel meal	Dilution cost	10 - 15	Fibre, Low protein fibre
Coffee pulp hull	Dilution, cost	2.5	Fibre
Cassava	Energy	20 - 50	Low protein, dustiness
Sorghum	Energy, protein	60	Tannin
Millet	Energy	20	
Cassava leave meal	Protein, pigment	15	Fibre, tannin
Bauhinia leaf meal	Pigment, protein	2.5	Low palatability tannin, nitrates
Gliricidia leaf meal	Pigment, protein	2.5	- do -
Leucena leaf meal	Pigment, protein	5	Mimosine,
Grass meal	Pigment	5	Fibre
Rubber seed meal	Energy	20 - 40	Antifertility amino acid def.

Source: S.A. Osei (1991), Dept. of Animal Science. Ghana.

Table 10: Yield of selected food crops: average for 1987-1990

Crop	Yield (Mt/Ha)	Achievable yield (Mt/Ha)*
Cassava	7.8	28.0
Plantain	7.1	10.0
Yam	6.1	10.0
Cocoyam	5.6	8.0
Groundnut	1.4	2.0
Maize	1.2	5.0
Rice	1.0	3.0
Cowpeas	0.9	2.0
Millet	0.7	2.0
Sorghum	0.7	2.5

* Indicate yields that have been achieved in isolated cases due to more effective extension and other logistic support.

Table 11: Estimated levels of per capita consumption of selected food crops

Commodity	Kg/1980	Head/1985	Year/1990
1. Roots and tubers,			
cassava,	145.2	146.3	148.0
yam	44.2	43.8	43.3
cocoyam	-	-	54.0
2. Plantain	82.2	82.5	83.0
3. Cereals	84.8	85.4	88.2
Maize	38.4	39.2	40.3
Rice	12.4	12.0	13.3
Millet	17.0	17.1	17.3
Sorghum	17.0	17.1	17.3
4. Pulses and nuts	22.4	22.5	22.6
Groundnuts	21.5	21.6	21.7
Cowpeas	0.9	0.9	0.9